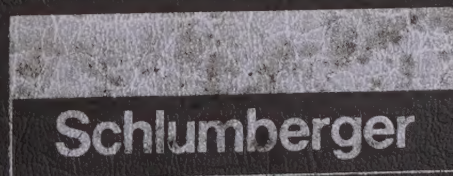


Manual contains the calibrating and operating procedures for the A

the preliminary introductions and control function descriptions, th  
h initial checks and calibrating instructions. The normal operating  
ow.

erating procedures are provided mainly for the inexperienced use



TECHNICAL DATA



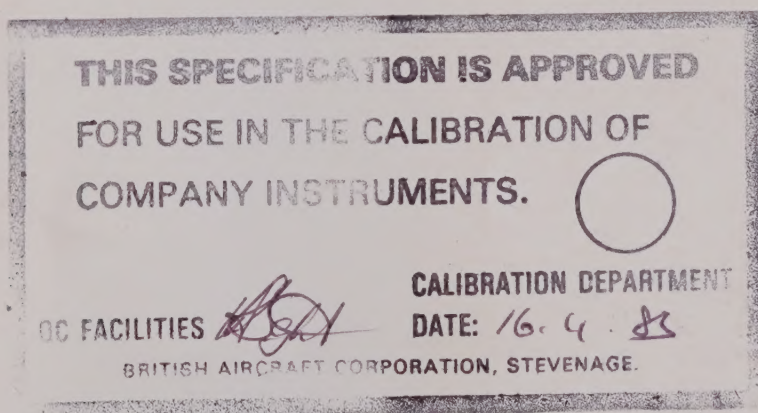
## INTRODUCTION

This manual contains the calibrating and operating procedures for the A100 oscilloscope system.

After the preliminary introductions and control function descriptions, the procedures begin with initial checks and calibrating instructions. The normal operating procedures then follow.

The operating procedures are provided mainly for the inexperienced user, and refer, in places, to the basic principles of oscilloscope use. These procedures may also be useful, however, to the more experienced for reference to specific information.

A full technical specification for each of the sub-units is given in section 5 of this manual.





# A100 MAIN FRAME UNIT

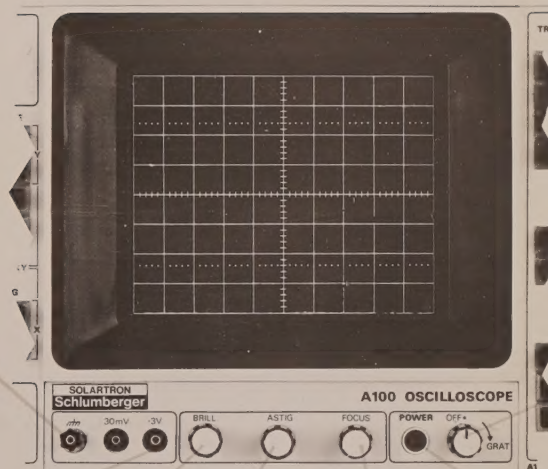
## INTRODUCTION

This unit contains the display tube, power supplies, and calibration circuits. It also provides two housings which accommodate the sub-units. A complete oscilloscope is formed by assembling a Y unit into the left-hand housing and an X unit into the right-hand housing. The complete instrument is available in two forms.

[a] A100, in a portable bench type case.

[b] A100R suitable for 19in. rack mounting.

With the exception of minor chassis differences and dimensions, both instruments are identical. All instructions contained in this manual apply to either assembly.



### Chassis/Earth Socket (2mm)

A signal earth point, connected to chassis and, via the mains lead, to mains earth. Its wiring is of insufficient gauge for use as a power earth.

### Calibration (30mV and 0.3V)

2mm sockets delivering 1kHz square-wave reference signals for calibrating the X and Y modules.

### BRILLiance

A continuously variable control which gives maximum trace brightness when fully clockwise.

### ASTIGmatism

This control determines spot shape and should be used in conjunction with BRILL and FOCUS to obtain optimum trace definition. On later models, this is a front-panel preset control.

### FOCUS

A variable control which provides optimum focus at approximately 'mid' position.

### Power

Mains ON/OFF switch, ganged to the graticule illumination control. Maximum graticule illumination is obtained with the control fully clockwise.

Graticule illumination is normally required only when a hood or camera is used. For use in normal lighting conditions therefore, and in the absence of a hood or camera, the control should be set to minimum in order to preserve filament life.

### Power Indicator

Indicates that the +ve and -ve stabilised d.c. supply rails are functioning and that the instrument has warmed up and is ready for use.

Reduced brilliance indicates a supply fault condition.

## CONTROLS AND CONNECTORS



# A101 DUAL VERTICAL DEFLECTION AMPLIFIER

## INTRODUCTION

This unit is a wideband, dual channel amplifier which provides switched, calibrated sensitivities of between 5mV/cm and 20V/cm over a bandwidth of d.c. to 30MHz. It may be operated in single, dual and additive modes. A delay line is fitted in the amplifier signal path which enables the timebase sweep to commence before the input signal is displayed.

### CALibration

A preset control used for fine adjustment of the sensitivity ranges.

### BALance

A preset, fine adjustment, control used to balance out slight trace movement as sensitivity is changed.

### X10 IN

A push-button switch which, when depressed, increases the selected sensitivity of the Y1 channel only, by a factor of 10. Under these conditions the bandwidth is 5Hz to 2.5MHz.

### Shift Control

A variable control which moves the trace vertically  $\pm 80\text{mm}$ .

### Fine Gain Control

A variable control which may be used to decrease the selected sensitivity by a factor of 2.5. The control has unlimited rotation with a spring loaded detent at CAL.

### Input Coupling Selector

A three position lever switch which provides selection of either AC or DC coupling, or earth. In the centre, earth, position [ *mm* ] the input socket is isolated and the amplifier input is connected to chassis.

### Sensitivity Selector (VOLTS/CM)

A twelve position rotary switch which selects the required sensitivity, within the range 5mV/cm to 20V/cm. The ranges are calibrated when the fine gain control is set to CAL.

### Y2 Invert Selector

A push-button switch which, when depressed, inverts the Y2 trace.

### Input Socket

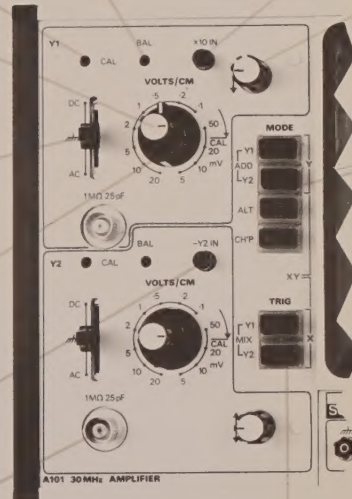
A BNC type connector.

### Mode Selector

A bank of four inter-dependent push-button switches, which provide a choice of three single trace and two dual trace modes of operation.

### Trigger Source Selector

Two push-button switches which select the channel routed to the X unit for triggering purposes.





# A111 SINGLE TIMEBASE UNIT

## INTRODUCTION

The A111 is a single timebase unit which provides, switched, calibrated sweep velocities of between  $0.1\mu\text{sec/cm}$  and  $0.5\text{sec/cm}$ ; the X5 IN and Fine Velocity controls extend the sweep speed to  $20\text{ns/cm}$  and  $1.25\text{sec/cm}$ . The sweep may be initiated by either an internal or external trigger source.

### Trigger (Coupling) Selectors

Three push-button switches used to select the type of coupling of the trigger or X input. Selection of any of these allows the trigger level to be set manually by use of the LEVEL control.

### Trigger (Mode) Selector

A push-button switch used to select the AUTO mode of trigger operation. This mode provides steady triggering without use of the LEVEL control.

### X Shift Control

A dual speed variable control which moves the trace left or right [1.1 screen widths], enabling either end of the trace to be centred even when fully expanded.

### Fine Velocity Control

A variable control which may be used to slow the selected timebase speed by at least 2.5:1. The control has a spring loaded detent at the CAL position.

### Sweep Speed Selector

A twenty-one position rotary switch used to select the timebase speed. The displayed sweep speed is accurate to the selected range only when the fine velocity control is set to CAL.

### Slope Selectors

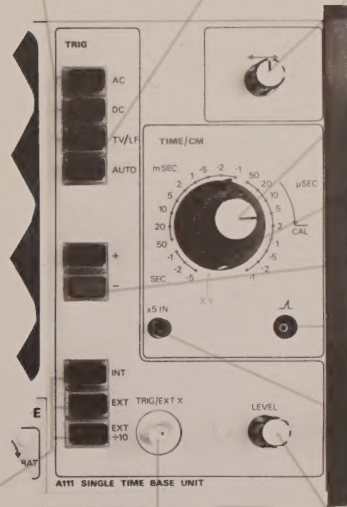
Two push-button switches which select triggering to occur on the +ve or -ve slope of the trigger input.



A 2mm socket at which the timebase ramp signal can be monitored when the sweep speed selector is set to a timebase range. With the selector set to XY either internal or external trigger signals can be monitored.

### X5 IN (times 5 selector)

A push-button switch which, when depressed, increases the gain of the X amplifier, thus increasing the sweep speed by a factor of 5.



### Trigger (Source) Selectors

Three push-button switches which select the trigger source and external trigger sensitivity.

### TRIG/EXT X

A BNC type connector which accepts external trigger or external X inputs.

### Level

A rotary control used to adjust the triggering level, when the timebase is operating in the AC, DC or TV/LF mode. The action of the control is inhibited when AUTO mode is selected.



### B Fine Vel

A variable control which slows the B sweep speed by a factor of up to 2.5:1. The control has a detent at the fully clockwise CAL position.

### Trigger (Coupling) Selectors

Three push-button switches used to select the type of coupling of the trigger or X input. Selection of any of these allows the trigger level to be set manually by use of the LEVEL control.

### Trigger (Mode) Selector

A push-button switch used to select the AUTO mode of trigger operation. This mode provides steady triggering without use of the LEVEL control.

### Slope Selectors

Two push-button switches which select triggering to occur on the +ve or -ve slope of the trigger input.

### X5 IN (times 5 selector)

A push-button switch which, when depressed, increases the gain of the X amplifier, thus increasing the displayed sweep speed by a factor of 5.

### Trigger (Source) Selectors

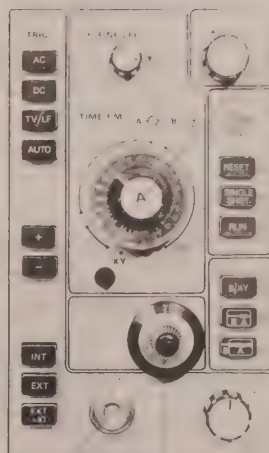
Three push-button switches which select the trigger source and external trigger sensitivity.

### TRIG/EXT X

A BNC type connector which accepts external trigger or external X inputs.

### X Shift Control

A dual speed variable control which moves the trace left or right (1.1 screen widths), enabling either end of the trace to be centred even when fully expanded.



A112 DUAL TIME BASE UNIT

### CM Delay

A ten-turn control, whose setting determines the starting position of the A timebase strobe along the B ramp. This gives a continuously variable delay time in the **B/A** mode.

### Sweep Speed Selector.

A dual 21-position switch to select the timebase sweep rates. The inner knob controls the A timebase, its sweep rate being indicated by the position of the white line on the knob. The outer castellated transparent knob controls the B timebase; its sweep rate is indicated by the position of the white dot against the background of white figures. When used in the single timebase mode (**B/Y** selected), only the outer selector is effective. The B timebase calibration is only accurate when the B Fine Velocity control is at CAL.

### Ready

A neon indicator lamp, which is illuminated when the timebase is ready to be fired by a trigger signal. It is only operative in the single shot mode.

### Single Shot Selectors

When **SINGLE SHOT** is depressed, the timebase will run for one sweep only, initiated by the trigger pulse. If a further single shot is required, depressing **RESET** will reset the timebase, and the 'Ready' lamp will light; the next trigger pulse will fire the timebase again. Depressing **RUN** will restore the timebase to normal repetitive operation.

### Delay Mode Selectors

The single timebase mode of operation is selected by depressing **B/Y**. The other two buttons give a pictorial representation of the two dual-timebase modes.



selects 'B intensified by A', and  
selects 'A delayed by B'.

### Trig Level

A rotary control used to adjust the triggering level, when the timebase is operating in the AC, DC, or TV/LF mode. The action of the control is inhibited when AUTO mode is selected.

## A 112 DUAL TIMEBASE UNIT

### INTRODUCTION

The A112 is a dual timebase unit, providing calibrated sweep and delay speeds from 100ns/cm to 0.5sec/cm. It also offers single timebase operation and XY plot facilities.

### ◀ CONTROLS AND CONNECTORS



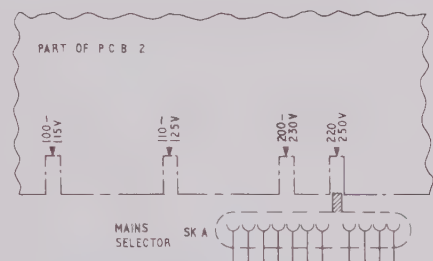
# PRELIMINARY OPERATIONS

## INITIAL CHECKS

The following instructions should be carried out on receipt of the instrument, before power is applied.

1. Check the setting of the mains supply selector as follows:-

Loosen the recessed captive screw at the rear of each side cover. Slide out the two side covers and the top cover from the rear of the instrument. Check that the mains selector is in the correct position for the local supply. Replace the top cover. Replace and secure the two side covers.



2. Check that a mains supply plug is correctly connected to the cable.
3. Check that the correct mains supply fuse is fitted [ 0.5A for 230V operation, 1A for 115V operation].

- 2a. If necessary connect as follows:- Line to brown. Neutral to blue. Earth to Green/Yellow.

The oscilloscope is now ready to display a basic trace. A simple method of obtaining a trace is described in the following section, INITIAL TRACE FINDING.

## INITIAL TRACE FINDING

Switch POWER on and check that the power indicator lights. If a trace is not visible after a warm-up period of approximately 30 seconds, locate the trace as follows:-

1. Set the BRILLiance, FOCUS and ASTIGmatism controls to approximately 'mid' position.

2. Set the controls on the X and Y modules as follows:-

|           |                                |              |
|-----------|--------------------------------|--------------|
| X unit    | TRIGger mode                   | AUTO         |
|           | TRIGger source                 | INT          |
|           | TRIGger coupling               | AC           |
|           | Shift control                  | mid-position |
|           | X5 IN                          | released     |
|           | TIME/CM or TIME/CM B           | 1m sec       |
|           | B FINE VEL                     | CAL          |
| A112 only | Single Shot Selectors          | RUN          |
|           | Delay Mode Selectors           | B            |
|           | Other controls not significant |              |

3. A trace should now be visible, if it is not carry out procedure 4.
4. Increase the brilliance to maximum then adjust the X and Y shift controls to centre the trace on the screen. Re-adjust the focus and brilliance controls to obtain optimum trace definition.

The oscilloscope is now ready for use. Before carrying out signal measurements, however, the sub-units should be calibrated as described in the USER CALIBRATION section.

USER CALIBRATION

The following user calibration procedures should be carried out at regular intervals. If an X or Y sub-unit is changed reference should be made to the technical manual for full calibration procedures.

1. If a trace is not already visible, obtain a trace as described in the preceding section, INITIAL TRACE FINDING.
2. Set the controls on the X and Y modules as follows:-

|           |                                |              |
|-----------|--------------------------------|--------------|
| X unit    | TRIGger mode                   | AUTO         |
|           | TRIGger source                 | INT          |
|           | TRIGger coupling               | AC           |
|           | TRIGger slope                  | +            |
|           | Shift control                  | mid-position |
|           | X5 IN                          | released     |
|           | B FINE VEL or                  |              |
|           | Fine velocity control          | CAL          |
|           | TIME/CM or TIME/CM B           | 1m sec       |
|           | Single Shot Selectors          | RUN          |
| A112 only | Delay Mode Selectors           | B            |
|           | Other controls not significant |              |
| Y Unit    | Sensitivity Y1                 | 50mV/cm      |
|           | Fine gain Y1                   | CAL          |
|           | Input coupling Y1              | DC           |
|           | Sensitivity Y2                 | 50mV/cm      |
|           | Fine gain Y2                   | CAL          |
|           | Input coupling Y2              |              |
|           | - Y2 IN [Invert Y2]            | released     |
|           | Mode                           | Y1           |
|           | Trigger                        | Y1           |
|           |                                |              |

3. Connect a lead from the 0.3V cal. socket to the Y1 input connector. A square wave signal should now be displayed on the screen. Check that one cycle of the square wave occupies exactly 1cm on the horizontal axis.
4. Adjust the Y1 shift control to position the top edge of the square wave one centimetre from the top of the graticule. If necessary, re-adjust the BRILLiance, FOCUS and ASTIG-matism controls to obtain optimum trace definition.
5. Adjust the Y1 CAL preset control to set the amplitude of the square wave to exactly 6cm peak to peak.
6. On the Y unit, set the mode selector and the trigger selector to Y2.
7. Transfer the input signal from Y1 to Y2. Set the Y1 input coupling selector to  and the Y2 selector to DC. Adjust the Y2 shift control to position the top edge of the square wave one centimetre from the top of the graticule.
8. Adjust the Y2 CAL preset control to set the amplitude of the square wave to exactly 6cm peak to peak. Remove the input lead.
9. Set the Y2 sensitivity selector to 20mV/cm and adjust the Y2 shift control to centre the trace on the screen.
10. Set the sensitivity selector to 50mV/cm and check that the trace is still in position on the centre line. If it is not, adjust the BAL. preset control to re-centre it.
11. Repeat procedures 9 and 10 until the trace remains in position when the Y2 sensitivity selector is switched between 20mV/cm and 50mV/cm.
12. Set the Y1 sensitivity selector to 20mV/cm and adjust the Y1 shift control to centre the trace on the screen.
13. Repeat procedure 10 and 12 until the trace remains in position when the Y1 sensitivity selector is switched between 20mV/cm and 50mV/cm.

The preceding information together with the published specification should enable the experienced user of oscilloscopes to use the A100 to its full capabilities. The following operating procedures, which are in the form of application notes, are provided mainly for the less experienced user. In places the procedures refer to the basic principles of oscilloscope use and describe how these principles may be applied to the A100.

Although the X and Y modules are used simultaneously their respective functions may be considered separately. Therefore, the following operating procedures are divided into separate sections. The first section describes the operation of the Ymodule and the second the operation of the X modules.

The sections are composed of various practical examples, each of which describes a particular method of operation. Each example gives a diagram of a typical trace waveform and a list of control settings which may have been used to obtain that waveform. After the control settings there is a description of the way in which the display may be interpreted.



# NORMAL OPERATING PROCEDURES

## A101 DUAL VERTICAL DEFLECTION AMPLIFIER

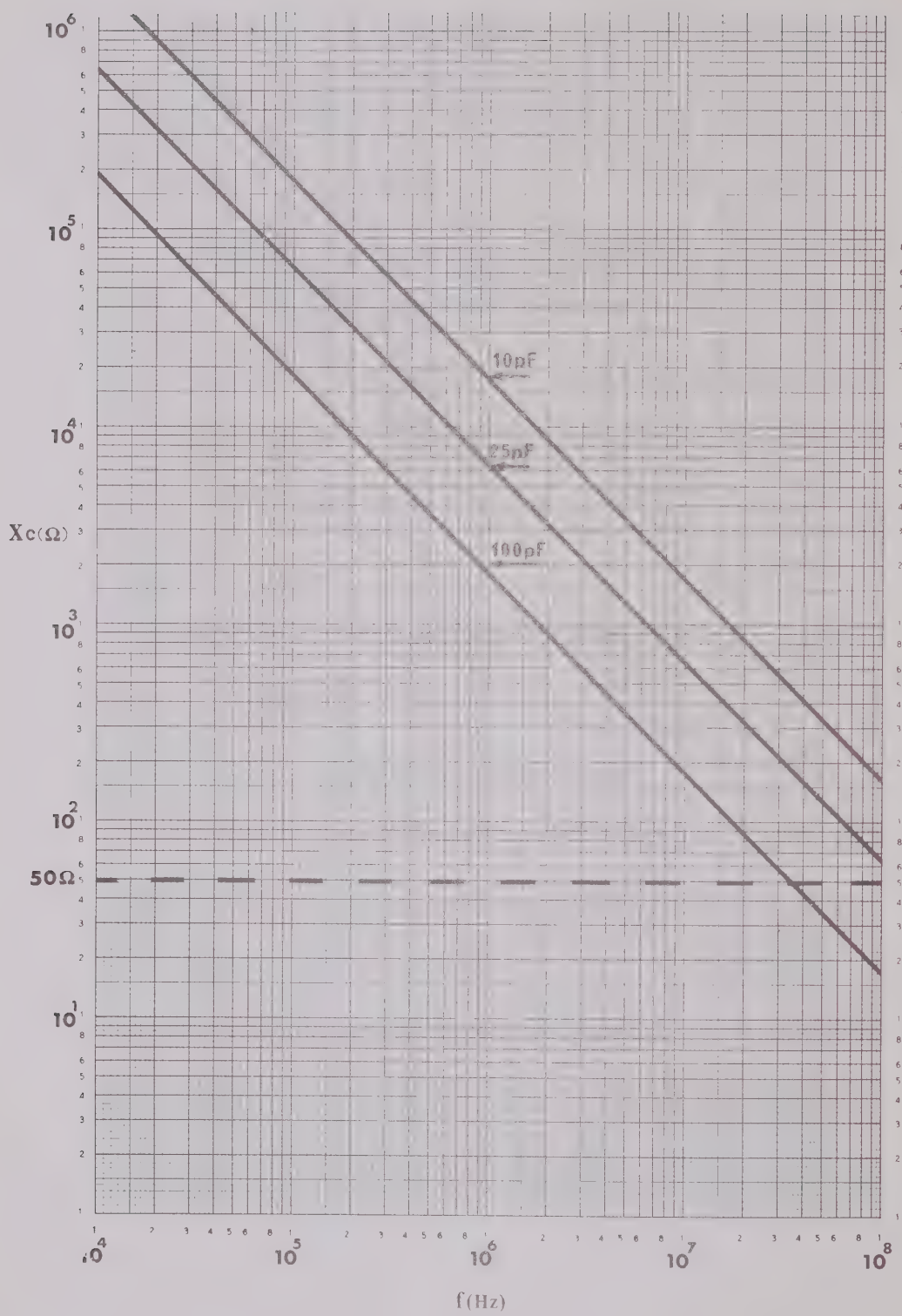
### INPUT CONNECTIONS

It is important that suitable connecting leads are used to the Y inputs. Unscreened connections should be used only for low frequency, high level signals as considerable interference may be picked up on this type of cable. A screened co-axial cable will be essential on most applications.

The capacitance of this cable [typically 20 pF/ft] naturally adds to the input capacitance of the oscilloscope. Thus the basic 25pF input capacitance of the A101 will be increased to nearly 90pF when used with a typical 1 metre co-axial input lead. This capacitive loading corresponds to a shunt reactance of about 200 $\Omega$  at 10MHz or about 70 $\Omega$  at 30MHz. Thus for all high frequency applications the 1M $\Omega$  input resistance is of no practical significance; it is the effect of capacitive loading which will severely attenuate HF signals. Except where frequencies and/or circuit impedances are really low, it is essential to employ a probe if meaningful displays are to be achieved. For example, even on a 100kHz sine wave signal from a 10k $\Omega$  source an error of approximately -35% would result on amplitude measurement due to the loading of the oscilloscope and its connecting lead. It is the capacitive loading which is responsible for this loss; with a 1MHz signal under similar conditions the resulting display would be only about one-sixth of the true value.

It will be appreciated that the attenuation is proportional to frequency, thus a pulse or complex waveform may appear very distorted due to the more severe attenuation of its HF components. The oscilloscope input circuit is acting as a low pass filter; i.e. pulses will suffer rounding of their edges. One must not only consider the misleading display under these conditions but the virtual certainty of an adverse effect on the circuit under test. The Reactance-Frequency chart shows the effect of reactance loading over a wide range of frequencies for different input capacitances; likely loading errors can then be estimated if the source resistance is known.

Many high frequency and pulse generators have a source resistance of 50 $\Omega$  and in these cases it is usually desirable to operate into a matched load i.e. with a terminating resistor [50 $\Omega$  pad] across the oscilloscope input. This will minimise reflections from the



Reactance/Frequency Chart

oscilloscope input circuit and hence standing waves on the connecting cable. Correct termination, which will halve the open circuit source voltage, is essential when checking the bandwidth of the instrument.

In many circuit applications where a terminating pad cannot be used the severe capacitive loading cannot be tolerated. The most satisfactory method of connection is then via a compensated probe, such as the CX3500. This passive probe introduces an attenuation of 10:1 which must obviously be allowed for when making measurements. It increases the input resistance presented to the circuit under test to  $10\text{M}\Omega$  and reduces the effective capacitance to approximately  $11\text{pF}$ . The full bandwidth of the Y amplifier is maintained when using the CX3500. It is very important that the compensation on a probe is correctly adjusted to ensure that all frequencies are attenuated equally. The necessary procedure is outlined in "The CX3500 Probe-Operation" in section 6 of this Manual. More detailed information is provided in the CX3500 Technical Manual.

An active probe may be used when the attenuation introduced by a passive probe is not acceptable.

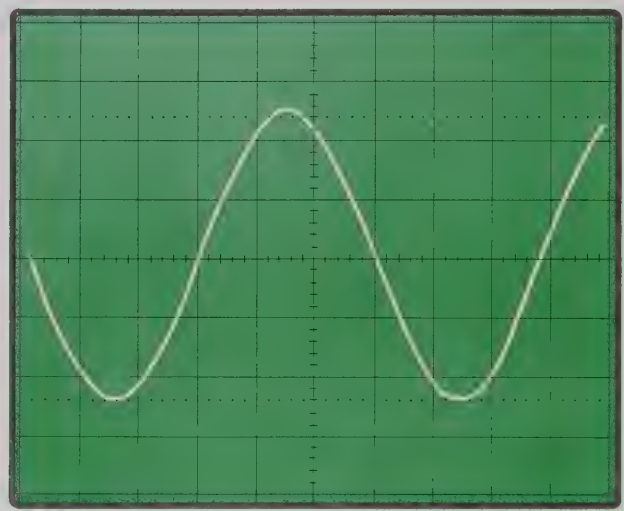
## TRIGGERING

Although triggering is a function of the X unit, the initial trigger signal is originated in the Y unit when internal triggering is selected. The display signal output from the Y pre-amplifier unit is routed to the Y deflection amplifier via a delay line, whereas the trigger signal output to the X unit for triggering [or XY plot] is routed directly. This allows the timebase to start its sweep before the vertical deflection begins, thereby enabling the leading edge of a fast pulse to be displayed.

The timebase will not synchronize without a suitable trigger signal. Therefore, the minimum vertical deflection that can be displayed is determined by the trigger characteristics of the X unit.

The following examples describe the operation of the Y module with various mode selections.

SINGLE TRACE (A.C.)



Control Settings

|                |          |
|----------------|----------|
| Sensitivity Y1 | 0.2V/cm  |
| Sensitivity Y2 | -        |
| Coupling Y1    | AC       |
| Coupling Y2    | -        |
| Mode           | Y1       |
| Invert Y2      | released |
| Trigger        | Y1       |

Signal applied to Y1 input

Interpretation

This is the method used to measure an a.c. voltage. Measurement is made in the normal way i.e. in this example the deflection is 4.9cm, peak to peak and the selected sensitivity is 0.2V/cm. Therefore, the trace represents an input voltage of  $4.9 \times 0.2 = 0.98\text{V}$  peak to peak or  $0.349\text{V r.m.s. [i.e. } \frac{V_{p-p}}{2\sqrt{2}}]$

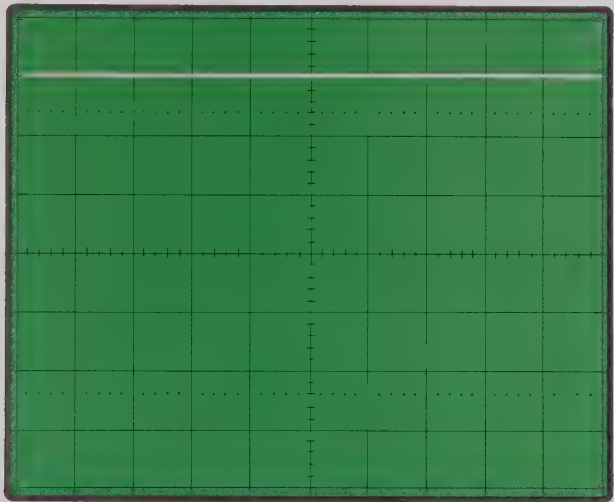
Although A.C. coupling is used in the example illustrated, D.C. coupling can also be used, providing that the d.c. level with respect to a.c. is not excessive, i.e. providing that the d.c. level is not more than approximately 1.5 times the full screen deflection voltage. D.C. coupling should always be used below 3Hz.

Any voltage between approximately 1mV and 160V [peak to peak] may be measured in this way up to a frequency of 30MHz, with the following qualifications:

1. The input connections to the Y unit must be suitable for the frequency and impedance of the circuit being measured.
2. All measurements must take into account the characteristics of the connecting leads or probes in use.

3. Readings taken at the upper bandwidth limit must be corrected to allow for frequency 'roll off' [i.e. at 30MHz the true value of a displayed sine wave will be:-  $V_{p-p} \times \sqrt{2}$ ].

**SINGLE TRACE D.C. (SETTING D.C. ZERO)**



**Control Settings**

|                    |                       |
|--------------------|-----------------------|
| Sensitivity Y1     | -                     |
| Sensitivity Y2     | -                     |
| Coupling Y1        |                       |
| Coupling Y2        |                       |
| Mode               | -                     |
| Trigger            | -                     |
| Trig Mode [X unit] | Auto [See page 4. 11] |

**Interpretation**

Before measuring a d.c. level it is necessary to establish the zero level. This example illustrates the method.

The position of the trace represents zero volts. It can be positioned anywhere on the screen by use of the shift control.

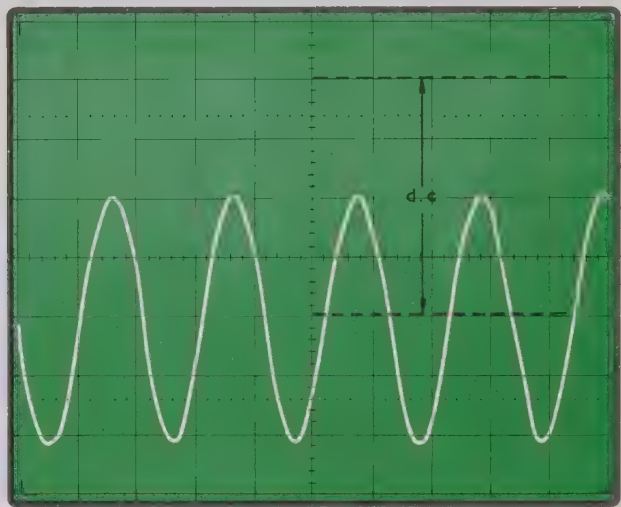
If the expected d.c. level is more negative than the a.c. peak value, the trace should be at the top of the screen. If the d.c. level is expected to be more positive, then the trace should be at the bottom of the screen.

Once the zero position has been established the shift control must not be moved again before the d.c. measurements have been taken.

The AUTO trigger mode must be selected on the X sub-unit, in order to obtain the d.c. zero trace.

NOTE: It may sometimes be found helpful, when measuring d.c. levels, to use the Y2 trace as a zero d.c. reference point. This may be easily achieved by simply setting the Y2 trace to the same position as the Y1, in the manner already described for Y1. The input signal can now be displayed on the Y1 trace, leaving Y2 as a constantly displayed reference point.

SINGLE TRACE D.C. (MEASUREMENT)



Control Settings

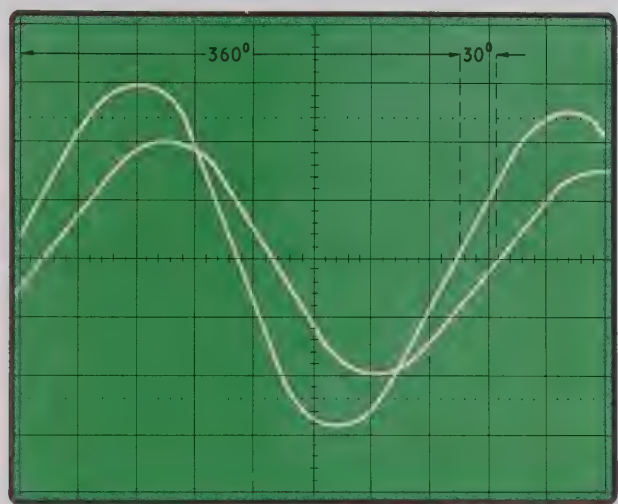
|                |          |
|----------------|----------|
| Sensitivity Y1 | 0.5V/cm  |
| Sensitivity Y2 | -        |
| Coupling Y1    | DC       |
| Coupling Y2    |          |
| Mode           | Y1       |
| Invert Y2      | released |
| Trigger        | Y1       |

Signal applied to Y1 input

Interpretation

The d.c. level is measured between the mean level of the a.c. and the zero d.c. reference point. In the example illustrated the d.c. deflection is 4.0cm. Therefore, the value of the d.c. signal level is  $4.0 \times 0.5 = 2.0\text{V d.c.}$

DUAL TRACE



Control Settings

|                |                     |
|----------------|---------------------|
| Sensitivity Y1 | 0.5V/cm             |
| Sensitivity Y2 | 1V/cm               |
| Coupling Y1    | AC                  |
| Coupling Y2    | AC                  |
| Mode           | ALTErnate [or CH'P] |
| Invert Y2      | released            |
| Trigger        | Y1 [or Y2]          |

Signals applied to Y1 and Y2 inputs.

Measurements

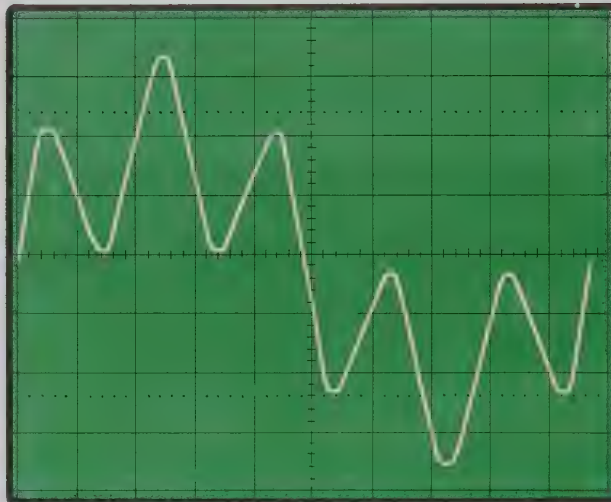
Y1,  $5.5 \times 0.5 = 2.75\text{V}$  [0.943V r.m.s.]  
Y2,  $3.8 \times 1 = 3.8\text{V}$  [1.35V r.m.s.]  
Phase angle 30 degrees.

The choice of mode [ALT or CHOP] depends mainly on the sweep speed selected on the X sub-unit. In general, ALT mode should be used on fast sweep speeds and the CHOP mode should be used on slow sweep speeds. Over a wide range of speeds, however, the choice will be arbitrary, in which case the ALT mode of operation is preferable.

The dual trace facility may be used with d.c. coupling for comparison of d.c. levels.

The choice of trigger [Y1 or Y2] depends on which trace is being used as a reference. If possible, the channel which is operating on the lowest frequency should be used to provide the trigger.

**SINGLE TRACE ADDED (Y1 + Y2)**



### Control Settings

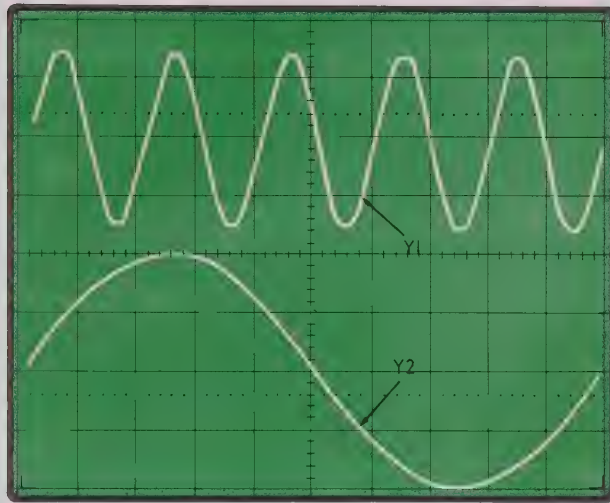
|                |                 |
|----------------|-----------------|
| Sensitivity Y1 | 1V/cm           |
| Sensitivity Y2 | 1V/cm           |
| Coupling Y1    | AC              |
| Coupling Y2    | AC              |
| Mode           | Y1 + Y2         |
| Invert Y2      | released        |
| Trigger        | Y1 and Y2 [MIX] |

Signals applied to Y1 and Y2 inputs.

Measurements 6.8 V (peak to peak)

This mode of operation is used to display the composite waveform which results from the addition of two inputs. If the two inputs are displayed separately in the dual trace mode and the mode is then changed to  $Y1 + Y2$  the effect of the addition and the resulting peak value can be ascertained.

In the example illustrated above, the trace is composed of the two components, Y1 and Y2, shown in the illustration on the following page.



#### **SINGLE TRACE ADDED ( $Y1 - Y2$ )**

The control selections for this mode of operation are exactly the same as those for  $Y1 + Y2$  except that in this mode the  $-Y2$  IN switch must be pressed.

This mode is often used as a differential amplifier, where the trace represents the difference between the  $Y1$  and  $Y2$  input signals. If this mode of operation is required, the outputs of the two amplifiers [ $Y1$  and  $Y2$ ] should be balanced as follows:-

Apply the same signal to the inputs of  $Y1$  and  $Y2$  simultaneously. Set both channels to the maximum, practicable, sensitivity [see next paragraph]. If a signal of more than a few mm is displayed, the amplifiers should be re-calibrated as described in the appropriate setting up instructions contained in the preceding sections of this manual. If the displayed signal is less than a few mm then it is a common mode voltage and should be eliminated by means of one of the variable fine gain controls.

Before this mode of operation is used, it is important to check that the individual signals do not overdrive the amplifiers. This check should be made by switching to dual trace and ensuring that neither trace greatly exceeds full screen amplitude at the sensitivity in use.

A111 SINGLE TIMEBASE UNIT

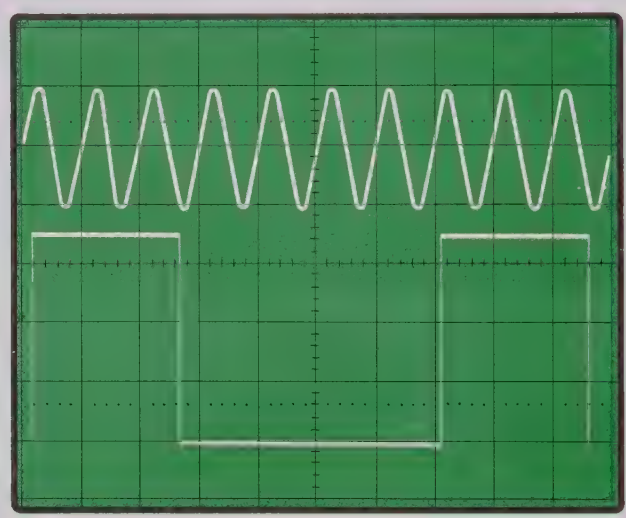
TRIGGERING

The A111 timebase unit requires the application of a recognisable trigger signal to initiate its sweep. If this signal is not received, the sweep will not commence and it will therefore be impossible to display a waveform. The choice of trigger source, either internal or external, depends mainly on the type of input signal.

The trigger system on the A100 oscilloscope has two basic modes of operation, level control and AUTO. The trigger operates in the level control mode whenever trigger coupling is selected [AC, DC or TV/LF] and in this mode the trigger level can be set by use of the LEVEL control. When AUTO is selected, the level mode of operation is inhibited and the trigger level is referred to the mean level of the input signal. If trigger coupling is subsequently selected the AUTO mode will be cancelled and the trigger operation returned to the level control mode.

The following examples describe the operation of the X sub-unit when used with various trigger selections.

AUTO TRIGGERING



Control Settings

|                |          |
|----------------|----------|
| Sweep speed    | 0.2ms/cm |
| Trigger mode   | Auto     |
| Trigger slope  | X        |
| x5 IN          | released |
| Trigger source | INT      |
| TRIG [Y unit]  | Y2       |

Signals applied to Y1 and Y2 inputs.

### Measurements

$$\begin{aligned} \text{[Y1]} \quad \text{Period} &= 1 \times 0.2\text{ms} = 0.0002\text{s} \\ f &= \frac{1}{0.0002} = 5\text{kHz} \end{aligned}$$

$$\begin{aligned} \text{[Y2]} \quad \text{Period} &= 7 \times 0.2\text{ms} = 0.0014\text{s} \\ \text{p.r.f.} &= \frac{1}{0.0014} = 714\text{Hz} \end{aligned}$$

This example explains basic time measurement and its relationship to frequency and pulse repetition frequency. The maximum sweep speed that can be obtained is 20ns/cm [0.1μs/cm selected and x5 pressed] enabling a 50MHz signal to be displayed at 1 cycle per cm.

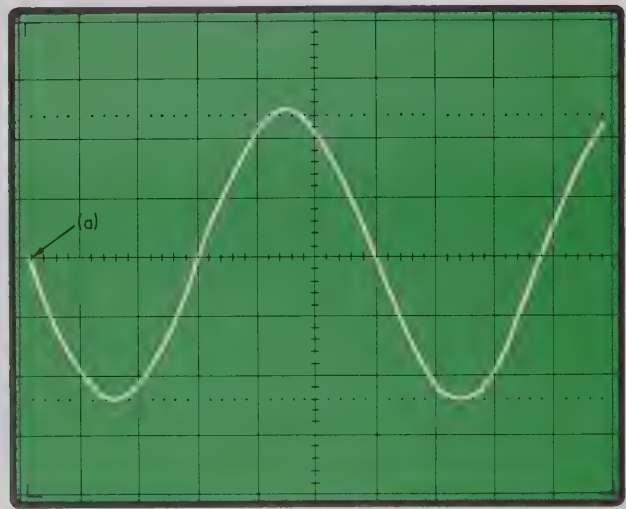
The Y2 channel provides the triggering signal by routing its pulse input to the X sub-unit [Y2 and INT trigger selected]. Although the pulse is acting as the trigger, the whole of the pulse is displayed due to the built-in, signal, delay in the Y sub-unit.

With AUTO selected the trigger level is at or near the mean level of the waveform. If no trigger signal is applied, the timebase will 'free run'. The timebase repetition frequency is then normally 40Hz at speeds below 20μs/cm and 3kHz at 10μs/cm and above. Thus a bright base-line is provided at all sweep speeds in the absence of a trigger signal.

Due to the 'free-running' arrangement on AUTO, difficulty may occur in obtaining steady triggering with small amplitude input signals of lower frequency than the timebase repetition frequency. This effect may be overcome, however, by increasing the amplitude of the input signal. Under these circumstances steady triggering can be achieved at frequencies considerably below the timebase repetition frequency. Triggering difficulty may also be experienced in this mode with input signals which have high mark-space ratios, ratios.

If satisfactory triggering cannot be achieved with AUTO selected, select AC or DC coupling, as appropriate, and adjust the LEVEL control. Steady triggering will now be achieved.

NORMAL TRIGGERING (LEVEL CONTROLLED)



Control Settings

|                  |          |
|------------------|----------|
| Sweep speed      | 1ms/cm   |
| Trigger slope    | -ve      |
| x5 IN            | released |
| Trigger coupling | AC       |
| Trigger source   | INT      |
| TRIG [Y unit]    | Y1       |

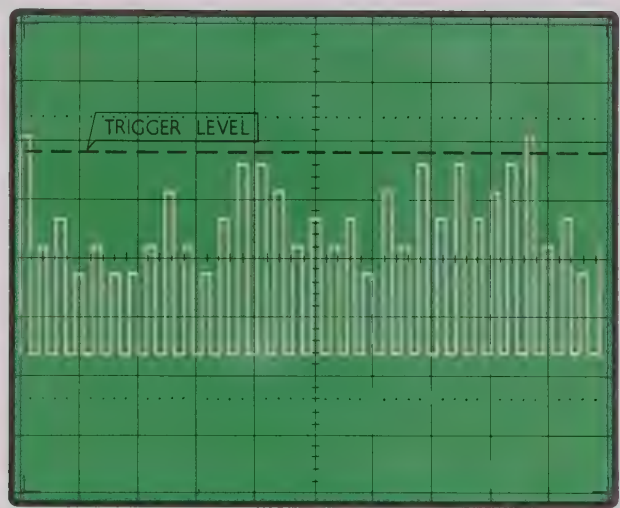
Signal applied to Y1 input.

NOTE: The trigger operates in the level control mode whenever AC, DC or TV/LF, trigger, coupling is selected.

In this example the trigger point is on the negative slope, at point [a]. The trigger point can, however, be positioned anywhere on the negative slope by use of the LEVEL control.

If +ve slope is selected triggering will occur on the positive slope, at a point determined by the setting of the LEVEL control.

PULSE TRIGGERING



Control Settings

|                  |          |
|------------------|----------|
| Sweep speed      | 1ms/cm   |
| Trigger slope    | -ve      |
| x5 IN            | released |
| Trigger coupling | DC       |
| Trigger source   | INT      |
| Trigger [Y unit] | Y1       |

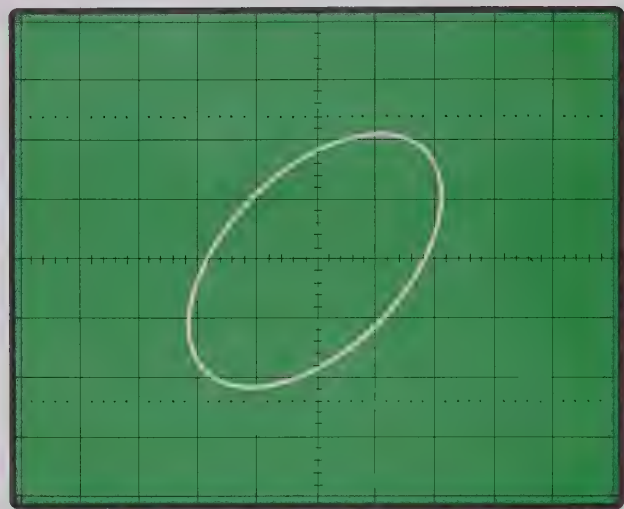
Signal applied to Y1 input

Interpretation

This example illustrates the type of triggering necessary for the display of an uneven pulse train. The figure shows a multilevel pulse train which is repetitive every 28 pulses. In order to display a steady trace, triggering must occur on only one recognisable pulse in each 28. In this case one pulse is easily recognisable by its amplitude. The trigger level should therefore be set to the level shown.

With this type of input signal it is only possible to use internal triggering if one of the pulses is recognisable by its amplitude. If this is not possible it may be desirable to use the external trigger input. For instance it may be possible to use a clock pulse associated with the signal as a trigger input, in which case EXT or EXT divided by 10 should be selected and the clock pulse connected to the TRIG/EXT X input.

XY PLOTTING



Control Settings

Y Unit

|                |          |
|----------------|----------|
| Sensitivity Y1 | 0.5V/cm  |
| Sensitivity Y2 | 0.5V/cm  |
| Coupling Y1    | DC       |
| Coupling Y2    | DC       |
| Mode           | Y2       |
| TRIG           | Y1       |
| X10 IN         | released |
| -Y2 IN         | released |

X Unit

|                            |         |
|----------------------------|---------|
| TIME/CM                    | XY      |
| Trig. coupling             | DC      |
| Trig. source               | INT     |
| X shift                    | central |
| Single shot [A112]         | RUN     |
| Other controls ineffective |         |

Interpretation

The trace above shows an XY plot of two equal-amplitude sine waves [2V peak-peak]; one is phase-shifted relative to the other. To measure this phase angle, the ellipse must first be centred vertically about a horizontal graticule line. Next, the maximum horizontal width, D1, is measured [4.3cm above], and then the distance, D2, between the points where the ellipse cuts the X axis [3.6cm above]. The phase angle,  $\theta$ , is given by the relationship

$$\theta = \text{Sin}^{-1} \frac{D2}{D1}$$

The measurements above result in a phase angle of 57°.

The A100 is particularly versatile when used in the XY mode. The various alternatives are best described in tabular form, as follows.

The Y attenuator settings and coupling controls depend on the individual application, though it is stressed that DC coupling should be used wherever possible, to avoid phase shift at low frequencies. Use of the Y1 X 10 amplifier gives AC coupling.

| Requirement                                    | Control Settings                    |                                                                     | Signal Inputs                                | Remarks                                                                   |
|------------------------------------------------|-------------------------------------|---------------------------------------------------------------------|----------------------------------------------|---------------------------------------------------------------------------|
|                                                | Y                                   | X                                                                   |                                              |                                                                           |
| Invert Y capability                            | Mode Y2<br>Trig Y1                  | Time/cm XY<br>Trig source INT<br>X shift central                    | Vertical Y2<br>Horizontal Y1                 | Press -Y2 to invert vertical signal                                       |
| Maximum sensitivity horizontal and vertical    | Mode Y1<br>Trig Y2<br>Press Y1 x 10 | Time/cm XY<br>X shift central<br>Trig source INT<br>Press x5        | Vertical Y1<br>Horizontal Y2                 | Maximum sensitivity<br>Vertical 500µV/cm<br>Horizontal 1mV/cm             |
| Maximum horizontal sensitivity                 | Mode Y2<br>Trig Y1<br>Press Y1 x 10 | Time/cm XY<br>X shift central<br>Trig source INT<br>Press x5        | Vertical Y2<br>Horizontal Y1                 | Maximum horizontal Sensitivity 100µV/cm                                   |
| Two individual Y signals against X             | Mode CHOP<br>Trig -                 | Time/cm XY<br>X shift as required<br>Trig source and x5 - see below | Vertical to Y1 and Y2<br>Horizontal to EXT X | Horizontal sensitivities see below<br>Y2 may be inverted by pressing -Y2. |
| Agebraically added Y1 and Y2 signals against X | Mode Y1 and Y2                      | Time/cm XY<br>X shift as required<br>Trig source and x5 - see below | Vertical to Y1 and Y2<br>Horizontal to EXT X | Horizontal sensitivitie. See below<br>For Y differential mode, press -Y2. |

Sensitivity

When used in the first three modes, a full range of horizontal sensitivities is available, as indicated on the appropriate Y attenuator. When used in the other two modes, four horizontal sensitivities are available - 100mV/cm, 500mV/cm, 1V/cm and 5V/cm, depending on the setting of the Trig Source and x5 IN selectors. Settings are tabulated below.

| Sensitivity | Trig Source | x5 IN button |
|-------------|-------------|--------------|
| 100 mV/cm   | EXT         | pressed      |
| 500 mV/cm   | EXT         | released     |
| 1V/cm       | EXT ÷ 10    | pressed      |
| 5V/cm       | EXT ÷ 10    | released.    |

Phase Shift

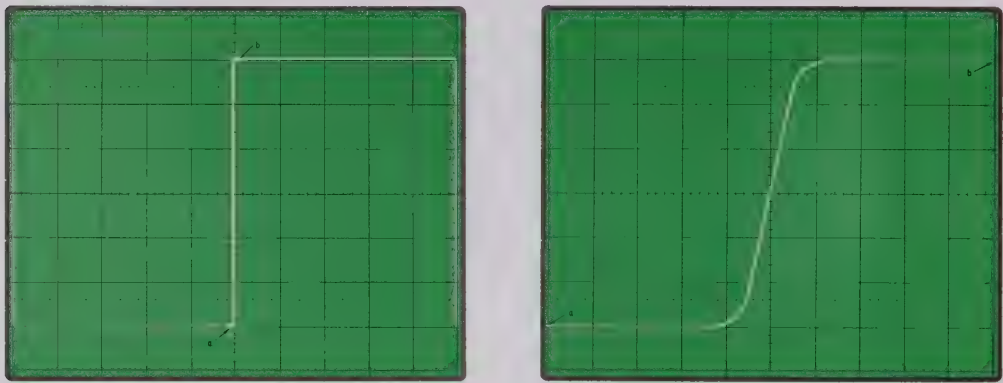
The horizontal bandwidth for full-screen deflection is typically 3MHz to the 3db down point, at which the phase shift is approximately 45 degrees. The latter stages of the Y amplifier contain the Y delay line, which gives a vertical signal phase shift of approximately 45 degrees at 1MHz; the frequency/phase shift relationship remains constant up to 20MHz.

A112 Dual Timebase Unit

The applications given for the A111 single timebase unit are valid for the A112 when the Single Shot Selectors are set to **RUN** and the Delay Mode Selectors to **B/XY**

The remainder of the circuitry is concerned with the delayed sweep and single shot modes.

DELAYED SWEEP MODE



Control Settings

|                       |            |
|-----------------------|------------|
| Trigger mode          | AUTO       |
| Trigger source        | INT        |
| Trigger coupling      | AC         |
| Trigger slope         | —          |
| X5 IN                 | released   |
| B FINE VEL            | CAL        |
| TIME/CM B             | 1ms        |
| TIME/CM A             | 20μs       |
| CM DELAY              | 4.95       |
| Single Shot Selectors | <b>RUN</b> |
| Delay Mode Selectors  | <b>B A</b> |

To obtain this trace, select **B A**

Interpretation

The basic sweep rate is the B timebase. The figures on the CM DELAY dial indicate that the A timebase will commence to run 4.95cm after the start of the B timebase. Therefore, with the settings shown, the A timebase start has been delayed until 4.95mS after the trigger pulse.

The main purpose of this system is to examine in detail a small section of a waveform. An obvious example is the rise-time of a rectangular pulse, as illustrated above.

The left-hand trace illustrates the single timebase mode of operation, except that there is a

brightened section of the trace, which indicates that the A timebase is running for that period. Examination of the control settings will show that the A timebase runs 50 times as fast as the B timebase, so that if the brightened section of the trace can be made to fill the screen, this will be equivalent to a X50 expansion of the B sweep trace. This is achieved by switching to the "A delayed by B" mode [button  pressed]. If the CM DELAY control calibration is exact, the waveform illustrated in the right hand picture will now appear.

In practice, it is seldom possible to obtain exact calibration of the CM DELAY control [or delay time multiplier, as it is sometimes called], and the rising portion of the waveform may not be in the centre. It may be off the screen altogether, in which case, slight re-adjustment of the CM DELAY control is necessary. The likelihood of this condition occurring depends to a large extent on the ratio of the two timebase speeds.

When large ratios of timebase speed are in use, two effects will be noticed.

1. The brightness of the trace will be reduced. This is because of the low repetition rate duty cycle. It can be remedied to a certain extent by adjustment of the brilliance control, but care must be taken to ensure that the brilliance control is reduced before switching back to the  mode otherwise the CRT phosphor may be damaged.
2. There may be a degree of jitter on the displayed trace, due to slight irregularities in the comparator level. The only remedy for this is to reduce the sweep speed ratio. The maximum jitter ratio is given in the module's specification.

## SINGLE SHOT

This facility is usually used in conjunction with a camera, or for observing non-repetitive traces, in which case the use of a viewing hood is recommended.

Selecting  inhibits the trigger action of the timebase and the screen will remain blank [after completing any sweep in progress on selection].

Depressing  will prime the circuit, ready for a single sweep to take place; the READY light will be lit indicating that the circuit is primed.

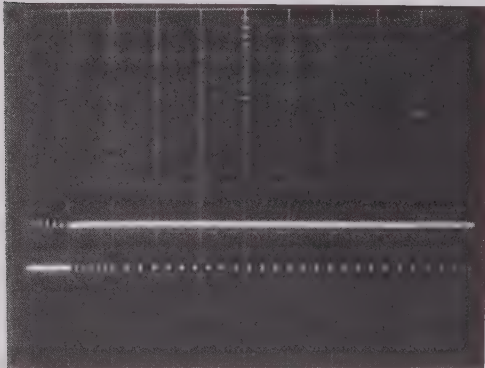
The next trigger pulse after the circuit is primed will cause a single sweep of the timebase, and extinguish the READY light.

When using a camera, if the trigger pulses are sufficiently infrequent or if the trigger is under control of the operator, the shutter should be opened after the READY light is lit and closed when the sweep is completed. If, on the other hand, the trigger pulses are of high frequency, the shutter should be opened before selecting RESET.

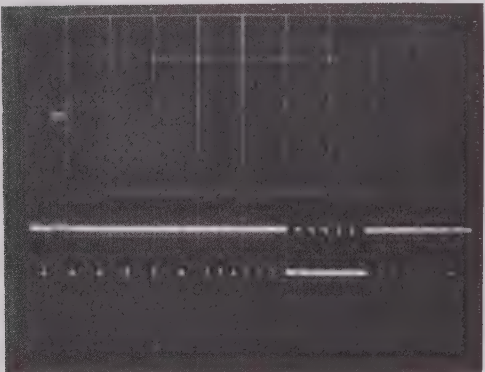
TELEVISION SIGNAL

Control Settings

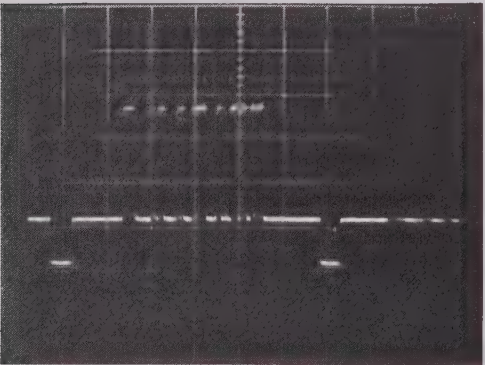
|                            |                |          |              |                                        |                |
|----------------------------|----------------|----------|--------------|----------------------------------------|----------------|
| Y Unit                     | Y2 sensitivity | 0.2V/cm  | X Unit       | Trig. coupling                         | TV/LF          |
| [All traces]               | Y2 coupling    | DC       | [All traces] | Trig. polarity                         | -ve            |
|                            | MODE           | Y2       |              | Trig. source                           | INT            |
|                            | TRIG           | Y2       |              | Single shot selectors                  | <div>RUN</div> |
|                            | -Y2 IN         | released |              | Trig. level adjusted for stable trace. |                |
| Signal applied to Y2 input |                |          |              |                                        |                |



|           |                  |       |
|-----------|------------------|-------|
| X Unit    | TIME/cm or       |       |
| [A 111 or | TIME/cm B        | 0.2ms |
| A 112]    | Fine velocity or |       |
|           | B FINE VEL       | CAL   |
|           | Delay mode       | B     |



|              |            |                |
|--------------|------------|----------------|
| X Unit       | TIME/cm B  | 2ms            |
| [A 112 only] | TIME/cm A  | 0.1ms          |
|              | B FINE VEL | CAL            |
|              | Delay mode | <div>B A</div> |
|              | CM DELAY   | 9.90           |



|              |            |                |
|--------------|------------|----------------|
| X Unit       | TIME/cm B  | 0.1ms          |
| [A 112 only] | TIME/cm A  | 10µs           |
|              | Delay mode | <div>B A</div> |
|              | CM DELAY   | 9.90           |

Adjust B FINE VEL to place first period of line information on the bright strobe at 9.9cm. Then select 

B A

 and this trace will appear.

## Introduction

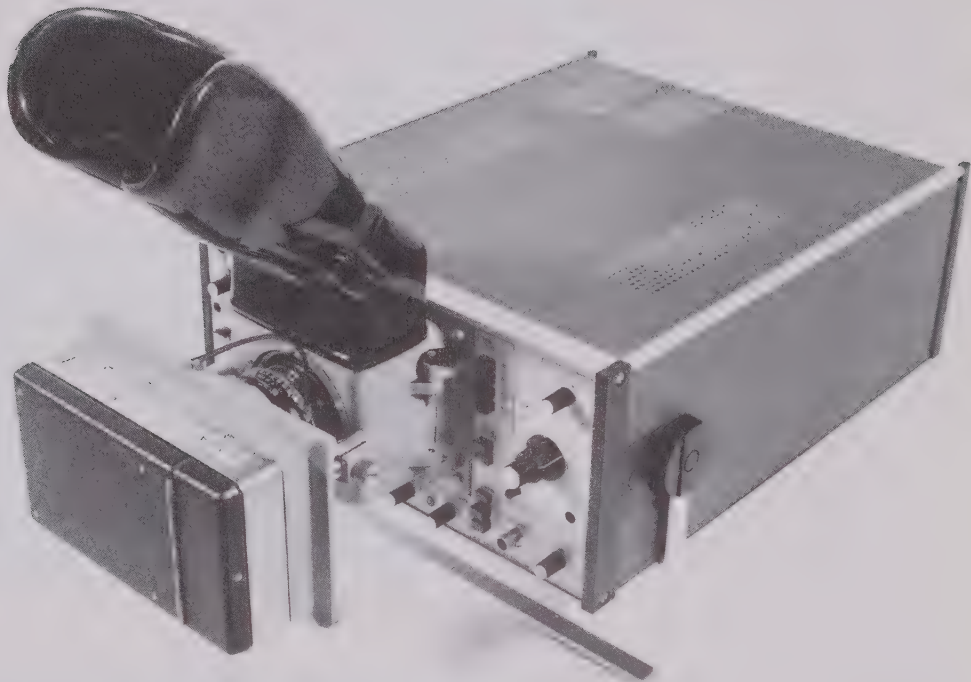
The TV/LF trigger coupling selector allows the trigger input circuit of the timebase to recognise television frame sync. pulses and reject line sync. pulses, which are of the same amplitude but of shorter duration. Thus, it is possible to display a complete frame, or the start of a frame, as shown in the first trace opposite. The X5 expansion switch allows more detailed examination, but if the A112 is in use, any part of the frame may be examined at any desired expansion, subject to the limitation of trace brightness; the middle and lower traces opposite show how this may be achieved. The traces were obtained from a digitally generated signal, thus they do not correspond exactly to a broadcast signal, but they are sufficient to allow recognition of the component parts of a composite video waveform.

The trace opposite shows the frame sync. pulse [which also contains half-line pulses to ensure that the line oscillator stays in lock], followed by the post field sync. equalisation pulses, the inter-frame blanking, and the start of the line information section.

The trace opposite shows the end of the line information section, five blank lines, pre-field sync. equalisation pulses, and then the next frame sync. pulse, after which the waveform will be as above. This trace necessitates the use of a delayed timebase, hence the A112 is required.

The trace opposite shows a line expanded for examination. The frame sync. pulse triggers the B timebase, which runs until the start of the section to be displayed, at which time the A timebase is triggered, and the waveform opposite is displayed [for a full explanation of dual timebase operation, see page 4, 16]. As the waveform was digitally generated, the front and back porches of the line sync. pulse [line blanking] are not displayed.

## TRACE PHOTOGRAPHY



The camera recommended for use with the A 100 is the "Shackman Super Seven Mk II". Full details are given in the handbook supplied with the camera.

To fit the camera, remove the black insert from the escutcheon assembly; this will reveal four blue-headed screws. Undo the screws and lift off the white escutcheon surround. Fit the camera mounting adaptor, type A26, using the existing blue-headed screws.

The required aperture and exposure settings depend on a number of variables, including the film speed, trace brilliance and graticule illumination. Optimum settings are best determined by taking trial photographs. As a general guide, the photographs on page 4.18 were taken using 3000 ASA Polaroid film type 107, at F5.6 for 0.5 second. The brilliance control was set for a trace slightly below normal brilliance, and the graticule illumination control at about 75% rotation. It should be borne in mind that the graticule lines are coloured red, thus slightly more illumination is required than for internal-graticule CRT faces.

# SPECIFICATIONS

## A100 MAIN FRAME UNIT

### Cathode Ray Tube

|               |                                                                                                                                                                                             |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Type:         | Mullard [Phillips] Type D14-121-GH, single gun, rectangular.                                                                                                                                |
| EHT:          | 10kV                                                                                                                                                                                        |
| Display Area: | 80mm x 100mm                                                                                                                                                                                |
| Graticule:    | Deposited on a perspex screen mounted in front of the tube face. Graduated in 10mm squares, 2mm divisions on major axes. Dotted lines at 10% and 90% of centre 60mm. Variable illumination. |
| Phosphor:     | Standard fitting — GH[P31] [Green, medium-short persistence].<br>Also available — GM[P7] [Yellowish-green, long persistence].<br>P39 [Green, medium-long persistence].                      |

### Calibrator

|                    |                                                   |
|--------------------|---------------------------------------------------|
| Frequency:         | 1kHz $\pm 1\%$ , square wave                      |
| Rise time:         | <100ns [+ve edge], <200ns [-ve edge]              |
| Voltage Reference: | 30mV $\pm 3\%$ and 300mV $\pm 1\%$ , peak to peak |

### Power Requirements

|                 |                                                      |
|-----------------|------------------------------------------------------|
| Supply Voltage: | 110-125V or 200-250V                                 |
| Frequency:      | 48Hz to 450Hz                                        |
| Power:          | 80VA [with X and Y sub-units fitted], at 240V, 50Hz. |
| Protection:     | 0.5A mains fuse [1A for 115V operation].             |

### Dimensions

|         |                  |
|---------|------------------|
| Height: | 177.8mm [7 in]   |
| Width:  | 356.6mm [14in]   |
| Depth:  | 419.1mm [16.5in] |

**Operating Temperature**

0<sup>o</sup>C to 50<sup>o</sup>C

**Storage Temperature**

-30<sup>o</sup>C to +70<sup>o</sup>C

**A101 DUAL VERTICAL DEFLECTION AMPLIFIER**

The following specification applies to the amplifiers when used in conjunction with the A100 main frame unit. The specification for both amplifiers [Y1 and Y2] is identical except that Y2 can be inverted and Y1 has an additional x10 gain position to give 500µV/cm sensitivity at a bandwidth of 5Hz to 1.5MHz.

**Bandwidth (-3dB)**

For full screen deflection on all calibrated ranges.

|               |               |
|---------------|---------------|
| d.c. coupled: | d.c. to 30MHz |
| a.c. coupled: | 3Hz to 30MHz  |

**Sensitivity**

5mV/cm to 20V/cm in 12 calibrated ranges, switched in 1, 2, 5 sequence, reducing to approximately 50V/cm by use of the fine gain control.

**Operating Modes**

- 1] Y1 only
- 2] Y2 only
- 3] Y1 + Y2 [by simultaneous selection of Y1 and Y2]
- 4] Y1 - Y2 [by simultaneous selection of Y1 and Y2, with Y2 inverted]
- 5] Y1 and Y2 alternately
- 6] Y1 and Y2 chopped [at approximately 200kHz]

**Input Impedance**

1MΩ ± 1% in parallel with 25pF on all ranges

**Maximum Input**

400V [d.c. + a.c. peak]

**Measuring Accuracy**

±5% [over the full Operating Temperature range].

**Coupling**

D.C. Earth, A.C.

**Rise Time**

< 12ns [10% to 90% on all calibrated ranges]

**Shift**

+80mm approximately

**Visible Signal Delay**

30ns

**Dimensions**

Height: 162mm [6.375in]

Width: 93mm [3.625in]

Depth: 277mm [10.9in]

**A111 SINGLE TIMEBASE UNIT****Sweep Range**

0.1 $\mu$ s/cm to 0.5s/cm in 21 calibrated ranges, switched in 1, 2, 5 sequence. The sweep range may be extended to 1.25s/cm by use of the fine velocity control and to 20ns/cm by use of the x5 selector.

**Accuracy**

+5% [0.1 $\mu$ s/cm to 0.2s/cm], +10% [0.5s/cm]

**Linearity**

Within 1% on all ranges

**X Shift**

Either end of the trace may be displayed with full expansion.

**X Expansion**

x5 +2% on all ranges

**External X**

Bandwidth [-3dB]

d. c. coupled; d. c. to 8MHz [up to 4cm deflection]

a. c. coupled; 10Hz to 8MHz [up to 4cm deflection]

Full screen deflection up to 3MHz

**Sensitivity**

External: 100mV/cm [with x5 expansion]  
500mV/cm [without x5 expansion]

External  $\div 10$ : 5V/cm

**Impedance (Trig/Ext X)**

1M $\Omega$  in parallel with 35pF on all ranges except TV[TV 100k $\Omega$ ].

**Maximum Input**

400V [d. c. + a. c. peak]

**Trigger Source**

- Internal
- External [via front panel BNC type connector]
- External ÷ 10 [via front panel BNC type connector]

These inputs may also be used as the X source on XY plot.

**Internal Trigger Sensitivity**

- AC or DC selected:
  - 2mm [d.c. to 10MHz]
  - 5mm [at 30MHz]
- TV/LF selected for use as LF filter:
  - 2mm [20Hz to 1kHz]
- TV/LF selected for frame pulse triggering:
  - Sync pulse height >1.5cm

**External Trigger Sensitivity**

- 100mV [d.c. to 10MHz]
- 250mV [at 30MHz]
- 500mV [at 50MHz]

**Trigger Selection**

- Auto:
  - This mode presents a stable trace without use of the level control. With no signal input a continual base line is displayed.
- AC or DC coupled:
  - The trigger operating point may be altered by use of the LEVEL control.
- TV/LF coupled:
  - This selection may be used to provide stable triggering from the frame pulses of a television signal. It may also be used as an LF filter.

**Dimensions**

- Height: 162mm [6.375in]
- Width: 93mm [3.625in]
- Depth: 277mm [10.9in]

A112 DUAL TIMEBASE UNIT

Sweep Range (A and B timebases)

0.1μs/cm to 0.5s/cm in 21 calibrated ranges, switched in 1, 2, 5 sequence. The B sweep range can be extended to 1.25s/cm by use of the B FINE VELOCITY control, and both timebases can be extended to 20ns/cm by the X5 expansion selector.

Accuracy (A and B timebases)

-5% [0.1μs/cm to 0.2s/cm] +10% [0.5s/cm]

Linearity (A and B timebases)

Within +1% on all ranges

Delay Time Multiplier Accuracy

0.1% or better.

X Shift

Either end of the trace may be displayed with full expansion.

X Expansion

x5 +2% on all ranges

External X

|                  |                |                                      |
|------------------|----------------|--------------------------------------|
| Bandwidth [-3dB] | d. c. coupled; | d. c. to 8MHz [up to 4cm deflection] |
|                  | a. c. coupled; | 10Hz to 8MHz [up to 4cm deflection]  |

Full screen deflection up to 3MHz

|             |               |                                                                 |
|-------------|---------------|-----------------------------------------------------------------|
| Sensitivity | External;     | 100mV/cm [with x5 expansion]<br>500mV/cm [without x5 expansion] |
|             | External ÷ 10 | 5V/cm                                                           |

Impedance (Trig/Ext X)

1MΩ in parallel with 35pF on all ranges except TV [TV 100kΩ].

Maximum Input

400V [d. c. +a. c. peak]

**Trigger Source**

Internal  
External [via front panel BNC type connector]  
External        10 [via front panel BNC type connector]

These inputs may also be used as the X source on XY plot.

**Internal Trigger Sensitivity**

AC or DC selected;                      2mm [d. c. to 10MHz]  
                                                 5mm [at 30MHz]

TV/LF selected for use  
as LF filter;                                2mm [20Hz to 1kHz]

TV/LF selected for frame  
pulse triggering;                         Sync pulse height >1.5cm

**External Trigger Sensitivity**

100mV [d. c. to 10MHz]  
250mV [at 30MHz]  
500mV [at 50MHz]

**Trigger Selection**

Auto:                                        This mode presents a stable trace without use of the level control. With no signal input a continual base line is displayed.

AC or DC coupled:                        The trigger operating point may be altered by use of the LEVEL control.

TV/LF coupled:                            This selection may be used to provide stable triggering from the frame pulses of a television signal. It may also be used as an LF filter.

**Delay Jitter**

Not more than 1 part in 20,000.

**Dimensions**

Height;                                    162mm [6.375in]  
Width;                                     93mm [3.625in]  
Depth;                                    277mm [10.9in]

# THE CX3500 PROBE

## INTRODUCTION

A ten times attenuating passive probe. Suitable for use with oscilloscopes which have an input capacitance of between 15 and 30pF and bandwidths up to 150MHz.

## SPECIFICATION

Attenuation:  $\times 10 \pm 2\%$

Input Impedance:  $10M\Omega$  in shunt with  $10.5pF \pm 1pF$

Will not alter the basic specification of the A100 oscilloscope system when used with that instrument.

## Setting Up and First Time Operation

Using the probe and any necessary adaptor sockets obtain a square wave trace of approx. 1kHz. Adjust the trace height to approx.  $\frac{3}{4}$  screen height and the width so that approx. 3 cycles are displayed.

Using the graticule lines as a gauge ensure that the top and bottom lines of the trace display no overshoot or droop, in which case the probe is ready for use.

If the trace is unsatisfactory, adjust the screw headed capacitor observed through the hole in the probe body to obtain the required shape.

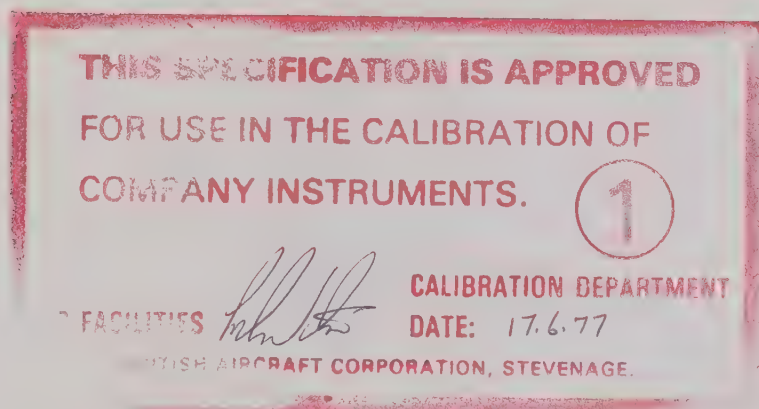
If the available range of adjustment is insufficient to obtain a satisfactory trace, refer to the calibration instructions in the maintenance section of the technical manual for the probe.

## Length

The overall length of the CX3500 is 1m. Two other probes are available in the series, namely, the CX3501 of 2m length and the CX3502 of 3m. The performance of the two probes is similar to that of the CX3500.



# A100 OSCILLOSCOPE SYSTEM



|                   |                               |
|-------------------|-------------------------------|
| Part No: A1000129 | Date of Issue: Novemeber 1972 |
|-------------------|-------------------------------|

THE SOLARTRON ELECTRONIC GROUP LTD.  
Farnborough · Hampshire · England · Telephone 44433  
Cables: Solartron Farnborough, Hants · Telex: 85245 Solartron Fnbro

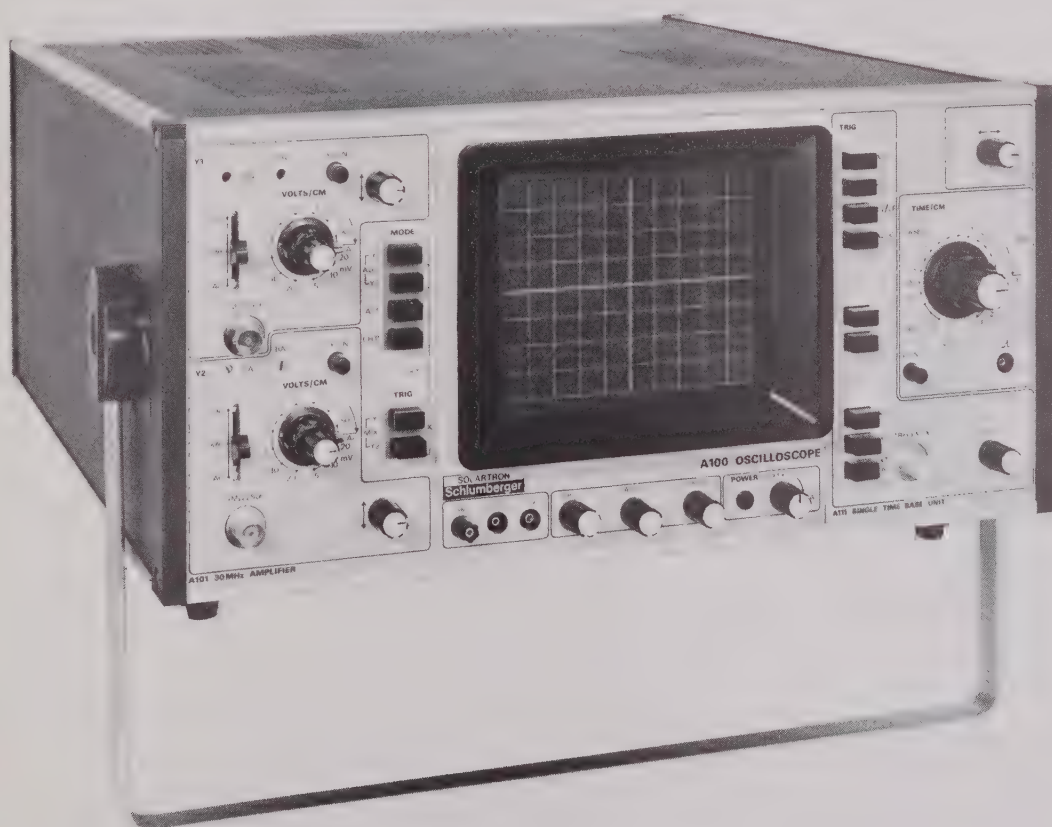
1972





# Schlumberger

## OSCILLOSCOPE SYSTEM A100



**THE SOLARTRON ELECTRONIC GROUP LTD**  
**FARNBOROUGH      HAMPSHIRE      ENGLAND**

Telephone: 44433. Cables: Solartron Farnborough, Hants. Telex: 85245 Solartron Fnbro

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# SECTION 7 Introduction

---

## Introduction

Each modular unit of the A100 has a separate section of the servicing manual allocated to it.

Each section contains the following information:-

1. Circuit diagrams
2. Circuit description
3. Component location and access information
4. PCB layout diagrams
5. Calibration procedures
6. Test information
7. Parts lists

Most of the information is contained in sub-sections, each based on a particular circuit diagram. The circuit diagram throws clear to the right of the book. Each circuit diagram has a complementary left hand throw-clear on a preceding page showing an identical blue background pattern, which contains descriptive text applicable to that circuit. In certain cases, where description is unnecessary, there is no complementary throw-clear to the circuit diagram, as with attenuator and switching diagrams. The pages between the left hand and right hand throw-clears contain information on component location, access, calibration and testing, applicable to that particular circuit.

This method of layout gives all the information necessary to investigate a fault, locate the components and recalibrate after rectification, contained in a small group of pages.

Information of a general nature, not applicable to a particular circuit diagram, is given at the beginning of each section. The parts list for each unit is given at the end of each section.

## Circuit Description

The overall circuit description is given in the form of a large scale block diagram, Fig. 7.1, showing an A100 main frame complete with an A101 Y-module and an A111 X-module.

## Functional Blocks

The circuit diagrams are broken down into functional blocks defined by a blue background and identified by a three or four letter reference. The background shape and reference are allocated to the blocks in both the circuit diagram and the block text diagram. The reference letters also apply to the overall block diagram for the A100 system (Fig. 7.1). As this block diagram throws clear to the left, it can be read in conjunction with the circuit diagram under consideration, thus establishing the position of the circuit in the overall system.

It should be noted that a circuit diagram is not necessarily that of a complete printed circuit board (pcb). Also, a circuit diagram may include parts of more than one pcb.

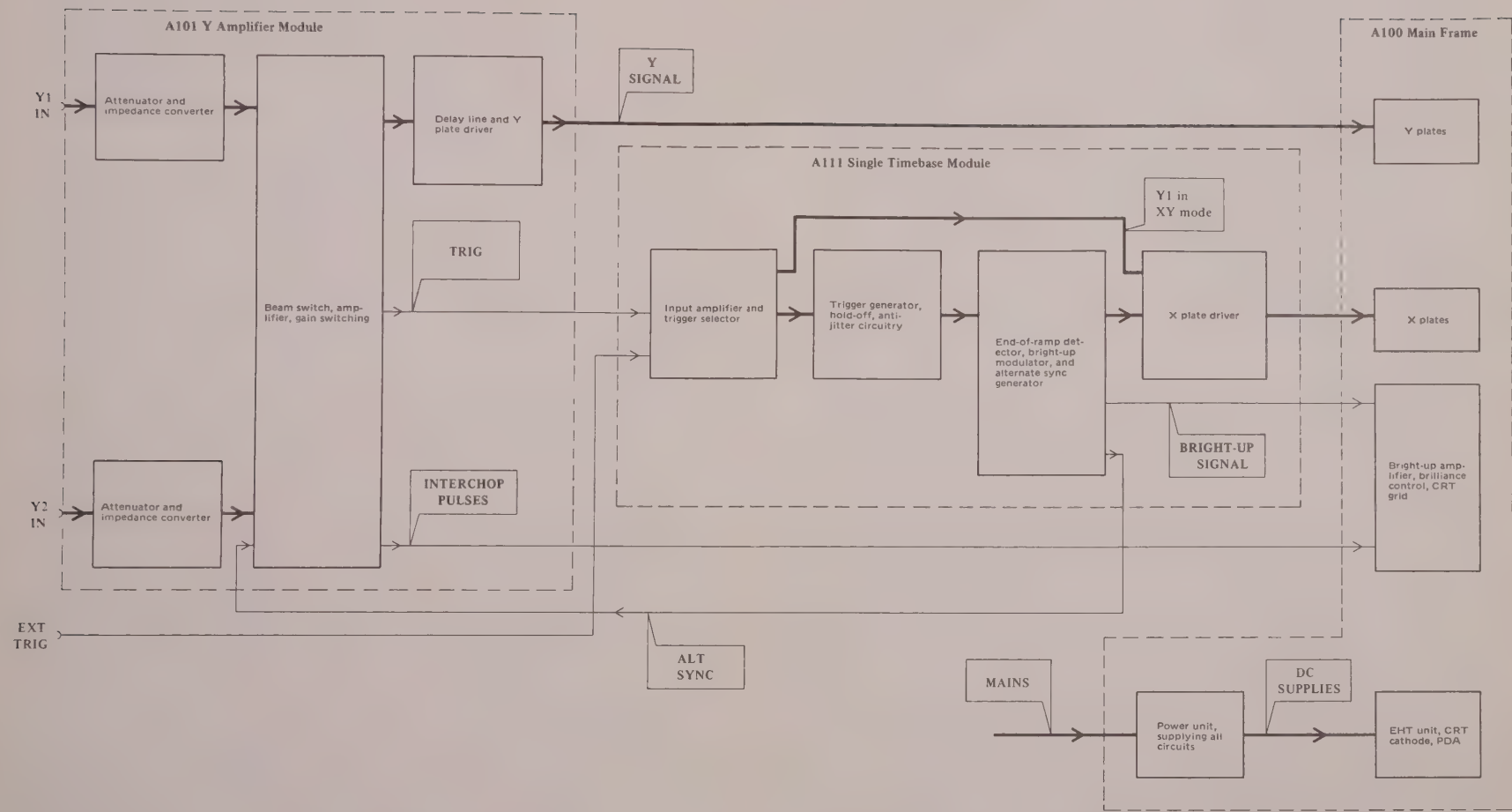


Fig. 7.1 A100 System Block Diagram

### Power Rails

Inside the functional blocks the power rails are depicted as short detached bars, annotated with the nominal voltage and with a reference letter where applicable. The decoupling and voltage dropping components, and in some cases voltage regulators, are given in separate diagrams on the same or an adjacent page.

### Component Numbering

Components are numbered with reference to the assembly or pcb on which they are mounted. On a circuit diagram, therefore, there may be more than one component carrying the same number. Great care must therefore be taken when locating a component by means of the pcb layout diagrams, or when identifying a component in the parts list, to ensure that the number is for that component on the correct pcb.

### Test Information

Test information points are indicated on most of the circuit diagrams and are located on the appropriate pcb layout diagram. The readings that may be obtained at these points are shown on an adjacent page. It is stressed, however, that indicated readings are only obtainable on a serviceable instrument under the test conditions specified at the beginning of each section.

It should be noted that the test information is given only for assistance in fault finding and should not be interpreted as calibration measurements. Also, later modifications may alter the readings shown.

### Calibration

The procedures given in this handbook assume, unless otherwise stated, that the covers have been removed and the instrument has been switched on for at least 30 minutes.

### Mechanical

#### Removal of Modules

1. Remove the top and side covers from the instrument. Each side panel is secured by one captive screw visible through a recessed hole in the moulded end flange of the panel. Undo the screw and slide the panel to the rear. The top panel can be slid out when the side panels are removed.
2. Remove the top front bar of the main frame. This is secured by six screws - one at each end and four along the top.
3. Remove the lower front securing screw of the module. This is visible through a D-shaped hole in the bottom plate of the main frame.
4. Disconnect the appropriate CRT plate leads.
5. Disconnect the film wire connector at the rear of the module.
6. Below the film wire connector, two blue screws can be seen. Slacken these about 2 turns.
7. Lift out the module.

#### Replacement of Modules

This is the reverse of the removal procedure; when replacing the Y module, care must be taken not to disturb the settings of the attenuator input capacitors.

The Y plate leads are coloured pink (upper) and white (lower). The X plate leads are coloured blue (left) and violet (right) as viewed from the front of the instrument.

## A100R RACK MOUNTING OSCILLOSCOPE

The A100R is a rack mounted version of the A100 oscilloscope, designed for standard 19 inch double-sided racks. The A100R, as supplied, includes a pair of runners in kit form, enabling the customer to assemble the runners to the dimensions of his rack.

The runners are assembled as shown in figs.7.3 and 7.4 and fitted to the rack by the outer set of holes. This will ensure that the runners are in the correct position to support the instrument.

When the instrument is installed in the rack, the grommets may be removed to allow connecting leads to pass from the rear of the rack to the front panel connectors.

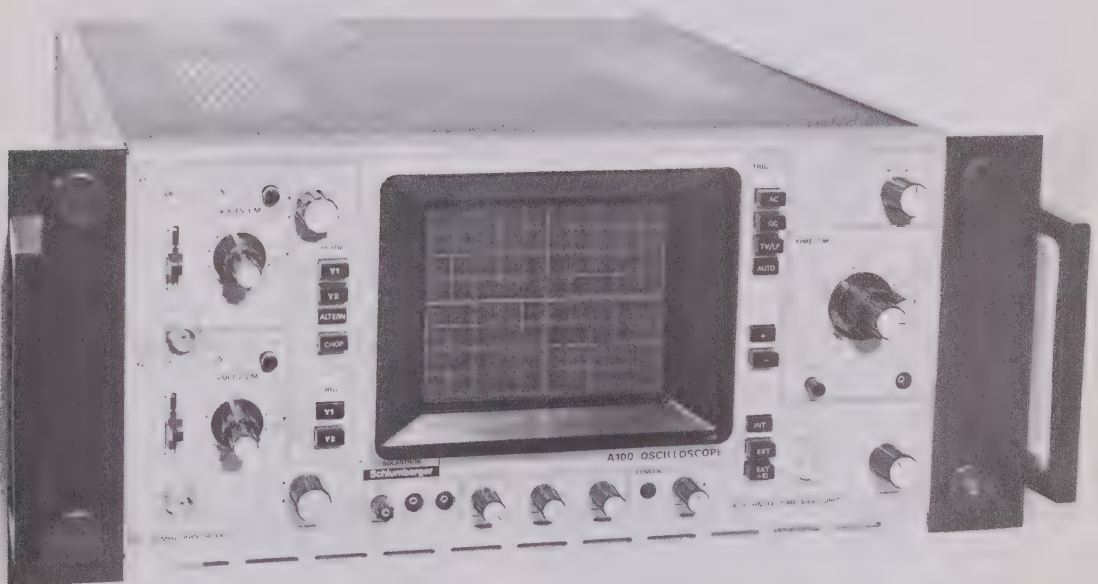


Fig.7.2 A100R - General View

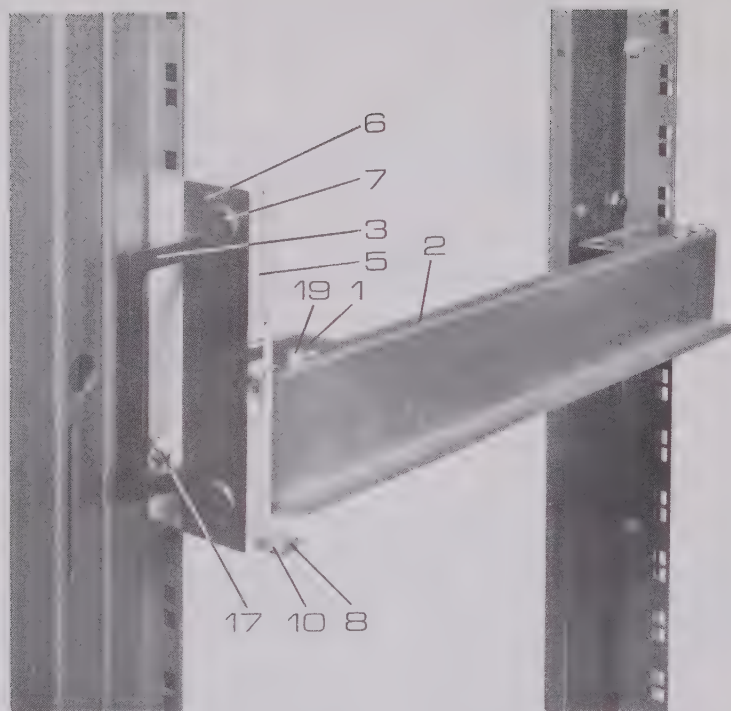


Fig.7.3 Rackmount Assembly - Front View

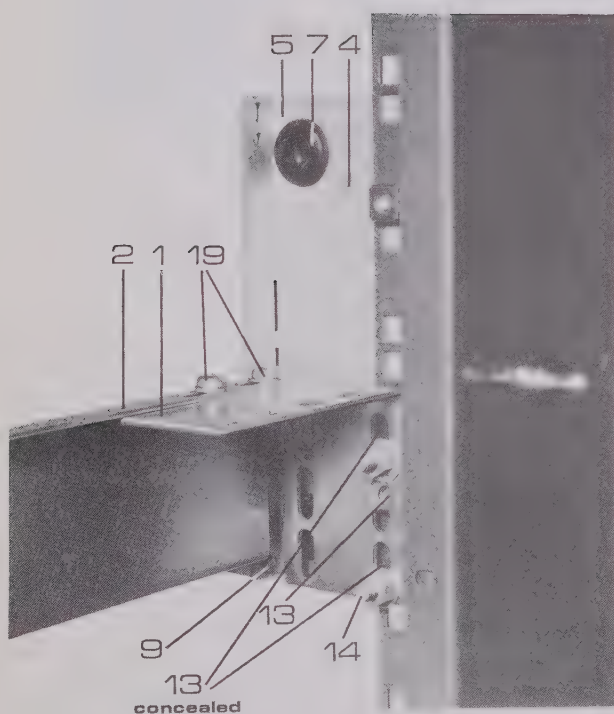


Fig.7.4 Rackmount Assembly - Detail Rear View

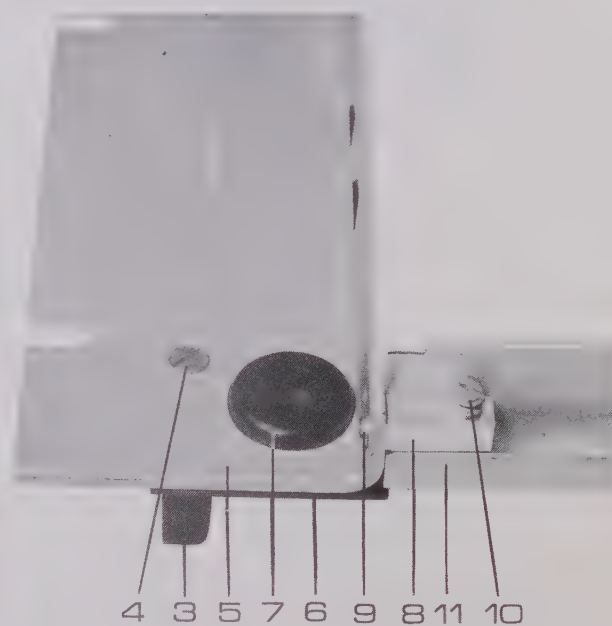


Fig.7.5 Rear View of Handle Assembly

### To Install the A100R in a Rack

1. Referring to fig. 7.4, fit cage nuts (item 13) to the front of the rack at the positions indicated.
2. Fit the special small-head screws to the cage nuts identified as “13 concealed” on fig.7.4. When screwed home, the special screw will spread the ears of the cage nut, thus securing it.
3. Fit cage nuts to the holes in the rear uprights which correspond to the holes identified in the paragraph above. Fit cage-nut screws to these.
4. Attach an angle bracket (item 1) to the front and rear, as shown in figs.7.3 and 7.4. Secure with nuts, (item 15) and washers (item 16). Before tightening, raise the bracket as far as possible.
5. Attach the runner (item 2) using OBA screws, nuts and washers, (items 19, 20 and 21). The runner may be fitted either above or below the angle bracket, depending on the exact dimensions of the rack.
6. Slide in the oscilloscope on the runners. Check that the D-shaped slots in the rack ears align with the appropriate cage nuts. If not, slacken the nuts securing the brackets and adjust as necessary.

### To Convert A100 to A100R

1. Remove the insert in the round escutcheon at each handle fixing point. This will expose the handle securing screws - undo the screws and remove the handle. Take out the bottom plate (see page 7.2), remove the four feet and replace the plate.
2. Assemble the rack ear components, items 3 to 10, as shown in figs. 7.5 and 7.6. Note that, although both rack ears are identical, the trim strip fixing blocks are fitted so that a left and right pair result. Note also that the trim strip grip screws are fitted with the screw head to the rear.
3. Remove the black vertical bar at each side of the instrument's front panel. Using the same screws, replace one with a rack ear assembly, with the trim strip block at the bottom.
4. Fit the trim strip, (item 11), around the trim strip block, with the slots outwards and the long flange upwards. Fit the other rack ear assembly to secure the trim strip.

**WARNING** - When securing the rack ear assemblies to the main frame, take care not to damage the threads in the aluminium top and bottom frame bars.

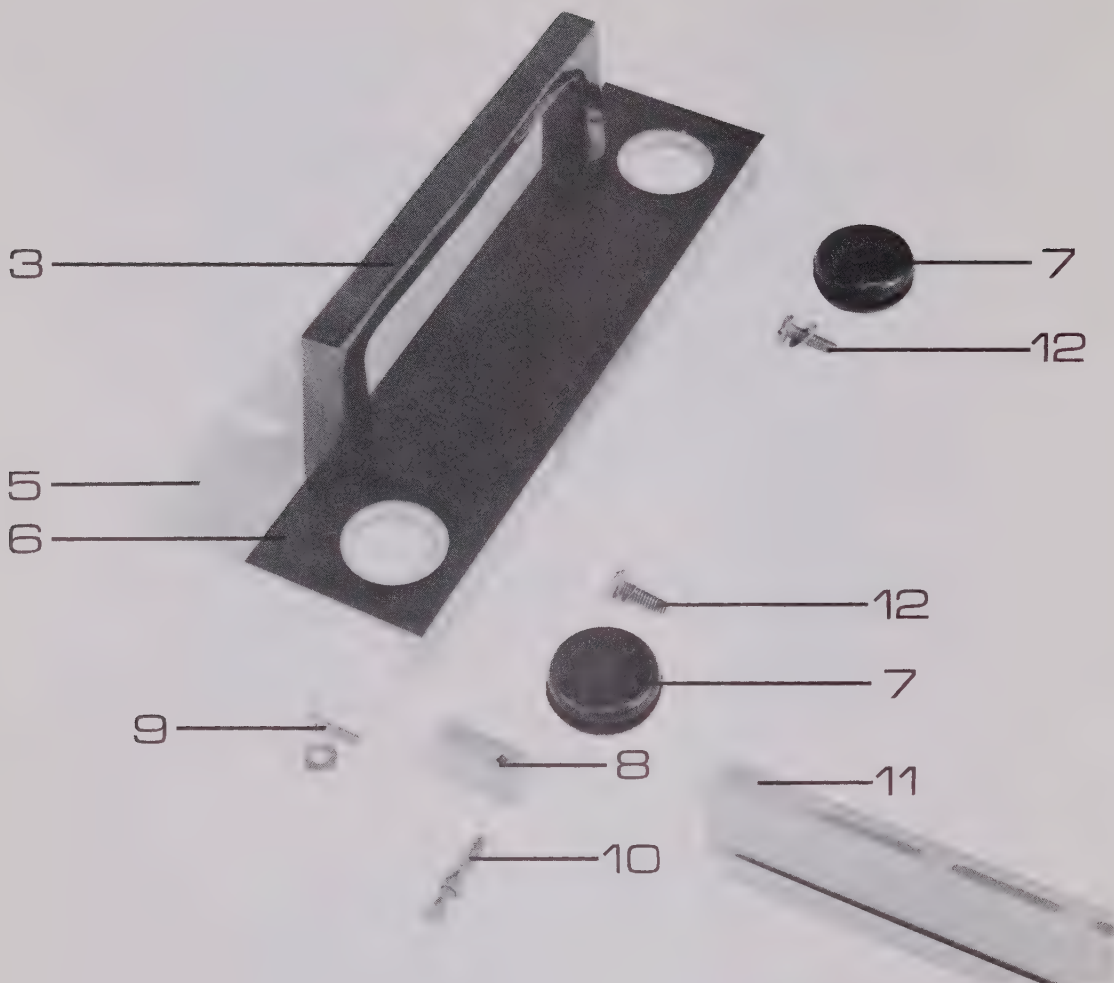


Fig.7.6 Handle and Trim Strip Components

Component Parts of Rackmount Modification Kit.

The following items of hardware are also required but not supplied.

| Component Parts of Rackmount Modification Kit. |                   | The following items of hardware are also required but not supplied. |                   |
|------------------------------------------------|-------------------|---------------------------------------------------------------------|-------------------|
| Item                                           | Quantity Supplied | Item                                                                | Quantity Required |
| 1. Angle bracket                               | 4                 | 13. Rack cage nuts                                                  | 12                |
| 2. Runner                                      | 2                 | 14. Cage nut screws                                                 | 8                 |
| 3. Handle                                      | 2                 | 15. Full nuts, same thread as cage nut                              | 8                 |
| 4. Handle securing screws                      | 4                 | 16. Washers for above                                               | 8                 |
| 5. Rack ear                                    | 2                 | 17. Instrument head screws, thread as cage nuts                     | 4                 |
| 6. Trim plate                                  | 2                 | 18. Washers for above                                               | 4                 |
| 7. Blind grommet                               | 4                 | 19. OBA x½inch or similar size screws                               | 8                 |
| 8. Trim strip fixing block                     | 2                 | 20. Full nuts for above                                             | 8                 |
| 9. Block securing screws                       | 2                 | 21. Washers for above                                               | 16                |
| 10. Trim strip grip screws and locknuts.       | 2                 |                                                                     |                   |
| 11. Trim strip                                 | 1                 |                                                                     |                   |
| 12. Main frame side member screws              | Part of A100      |                                                                     |                   |

If an A100R is ordered, items 3 - 12 will already be fitted

# SECTION 8 Main Frame A100

---

This section contains all calibration procedures, circuit diagrams and descriptive text for the A100 main frame.

The main frame unit consists of the CRT circuitry, power supplies, bright-up amplifier and calibrator. The remainder of the oscilloscope is contained in the X and Y modules which are mounted in the main frame. A descriptive block diagram of the main frame is given in Fig. 8.4 on page 8.5.

## Outline Calibration Procedures

For a full calibration, adjustments should be made in the order given in table 8.1.

Table 8.1 A100 Calibration

| Procedure | Description                             | Test Equipment Required |
|-----------|-----------------------------------------|-------------------------|
| 100 Cal 1 | Power supply voltages and ripple levels | 1, 2                    |
| 100 Cal 2 | EHT voltages and ripple levels          | 1, 2, 4, 5, 6           |
| 100 Cal 3 | CRT trace alignment and geometry        |                         |
| 100 Cal 4 | Bright-up amplifier                     | 1, 2, 5, 7              |
| 100 Cal 5 | Calibrator                              | 2, 3                    |

## Test Equipment Requirements

| Item | Description           | Minimum Specification   | Suggested Instrument |
|------|-----------------------|-------------------------|----------------------|
| 1    | Test oscilloscope     | 10mV/cm, 12ns risetime  | Solartron A100       |
| 2    | Digital voltmeter     | 30mV - 1600V $\pm$ 0.1% |                      |
| 3    | Frequency counter     | 1 kHz                   |                      |
| 4    | Variac transformer    | Mains nominal $\pm$ 10% |                      |
| 5    | High impedance probe  | 10M $\Omega$            | Solartron CX3500     |
| 6    | Blocking capacitor    | 0.01 $\mu$ F 2kV        |                      |
| 7    | Square wave generator | 1MHz 1ns risetime       | Tektronix 106        |
| 8    | A101 Y amplifier      |                         |                      |
| 9    | A111 or A112 timebase |                         |                      |

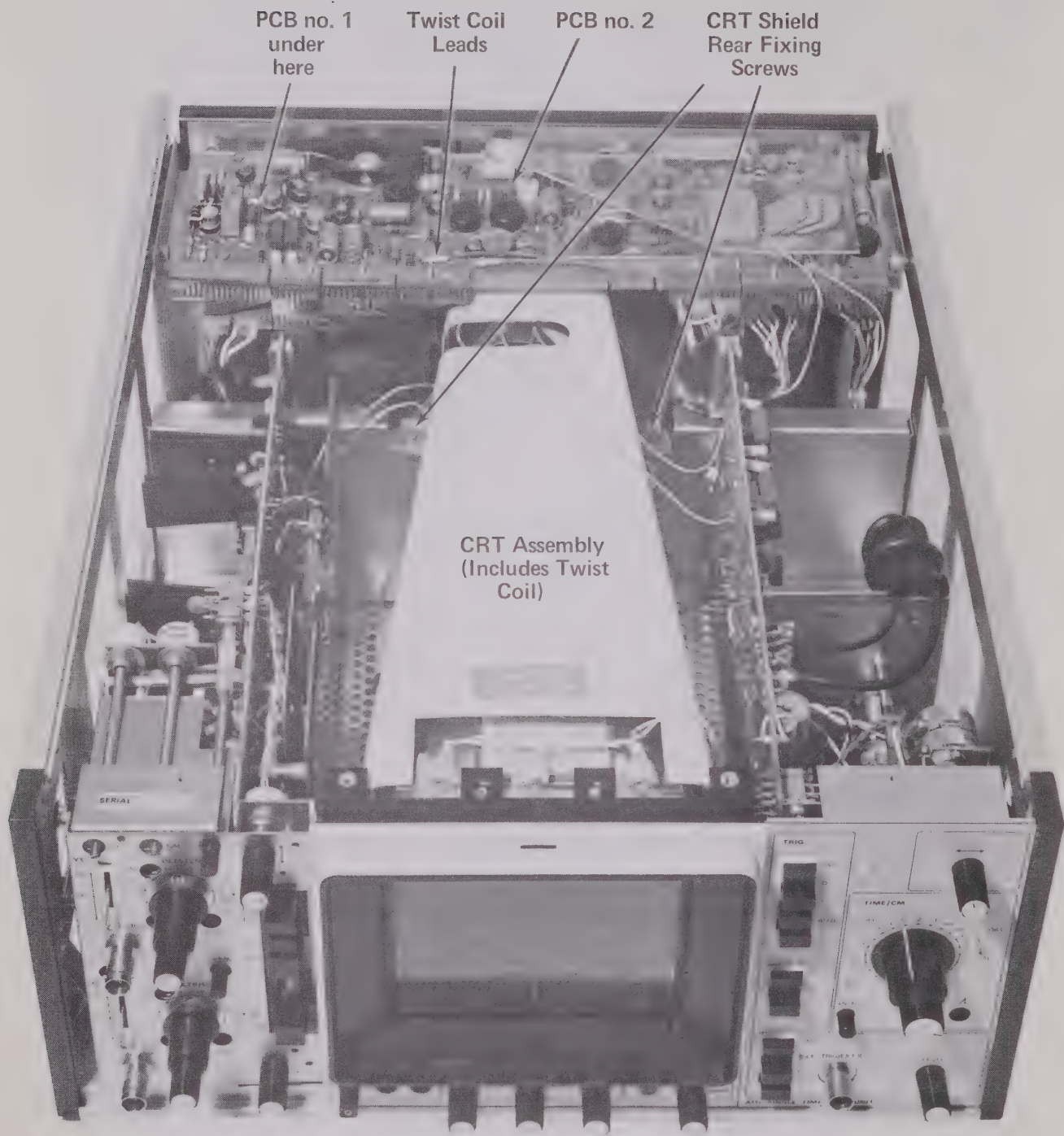


Fig. 8.1 A100 System Top View

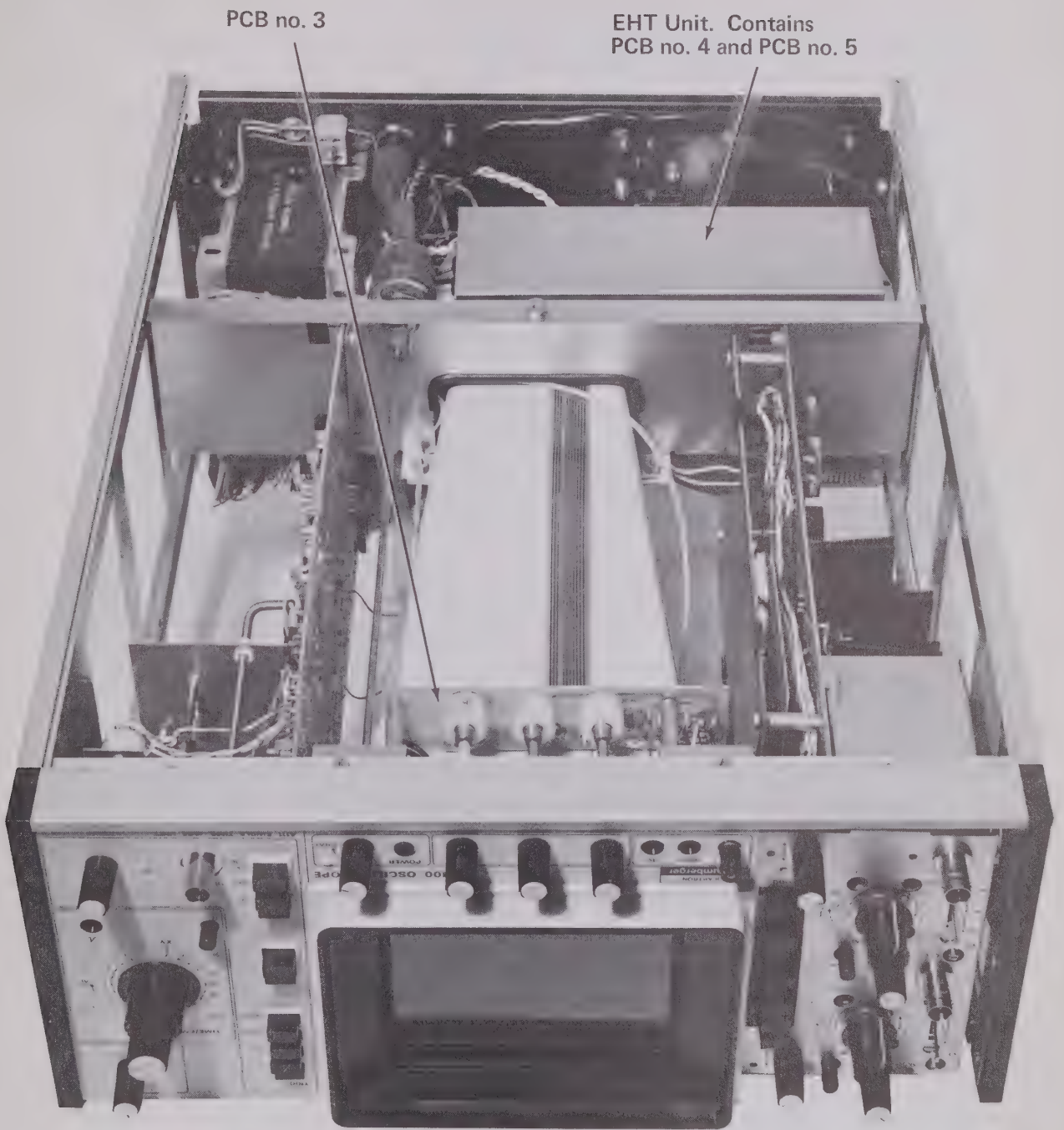


Fig. 8.2 A100 System Bottom View

### Removal and Replacement of the CRT

1. Remove the top and side covers and the top front bar from the main frame. (See page 7.2 - 'Removal of modules' para. 1 and 2).
2. Referring to Fig. 8.3a, remove screws from both sides of the instrument at locations marked 'A'. Loosen those marked 'B'.
3. Remove the protective cover from pcb no. 2.
4. Remove all connections from pcb no. 2, including the two leads soldered to points near TP12.
5. Hinge back the power unit assembly as shown in Fig. 8.3a. **Caution - ensure that the film wire assemblies are not in a position where they may be damaged.**
6. Remove the CRT base from the tube.
7. Remove the black insert from the CRT bezel. This will expose four screws securing the white surround; undo these screws and remove the bezel.
8. Referring to Fig.8.3b, remove the two screws marked 'C'.
9. Remove the two CRT shield rear fixing screws (See Fig. 8.1).
10. Remove the leads from the CRT plate pins.
11. Disconnect the PDA cap and short its nipple to chassis. (**Caution - this connector carries 8.5kV**).
12. Using a clip lead, short the PDA of the CRT to chassis. If a spark results, wait for 5 minutes and repeat the operation.
13. Lift out the CRT assembly.
14. Remove the four screws marked 'D' on Fig. 8.3b and pull the graticule assembly away from the CRT face.
15. Slide the CRT out from the shield.
16. Remove the gun shield and twist coil.
17. Re-assemble in the reverse order. When re-connecting the two soldered leads to pcb no. 2, the wire coloured **violet/white/red** is connected to the forward end of C38, just behind TP12, and the wire coloured **violet** is connected to the forward end of a 560k $\Omega$  resistor (R54) to the right of TP12.

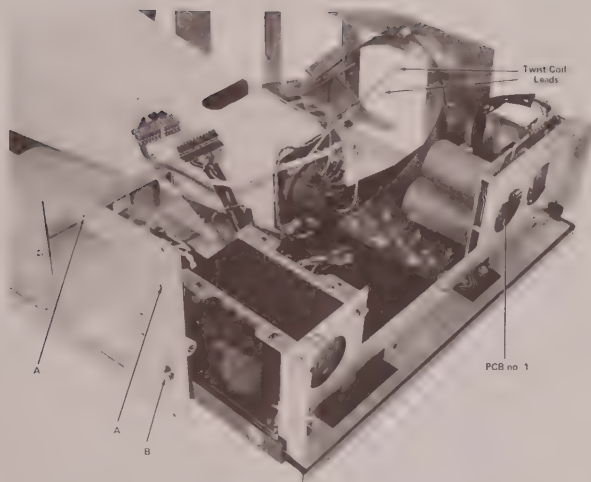


Fig. 8.3a CRT Removal

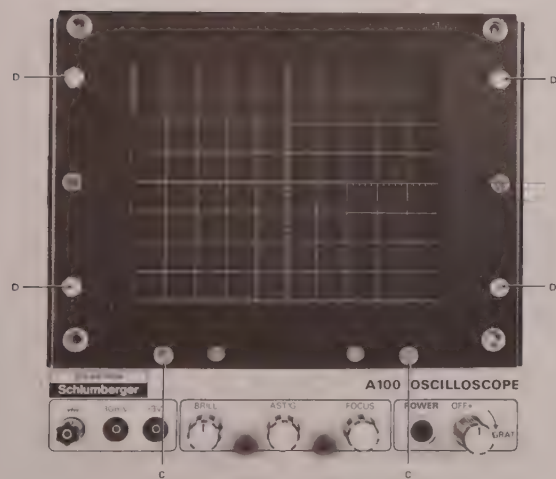


Fig. 8.3b CRT Removal

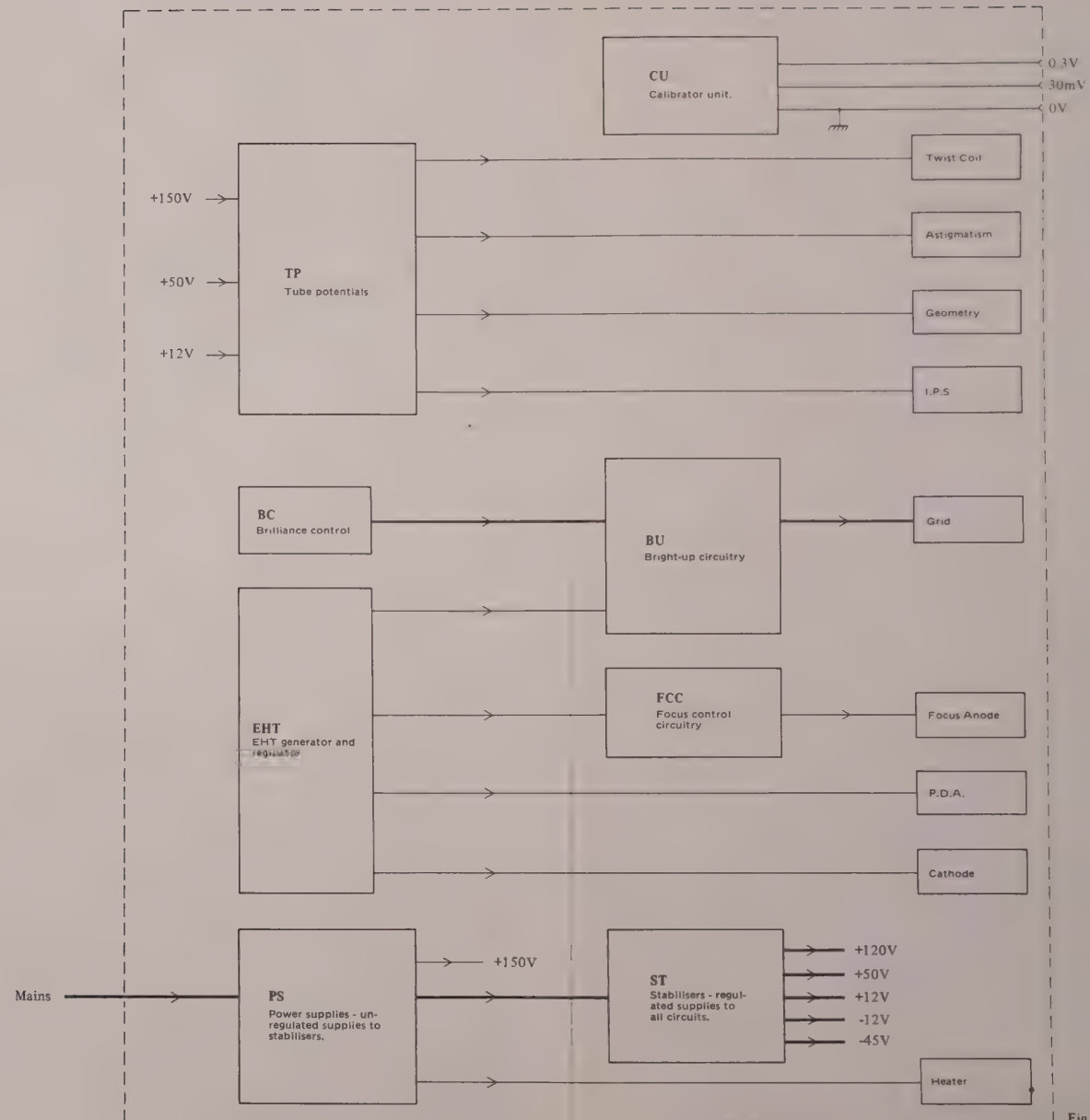
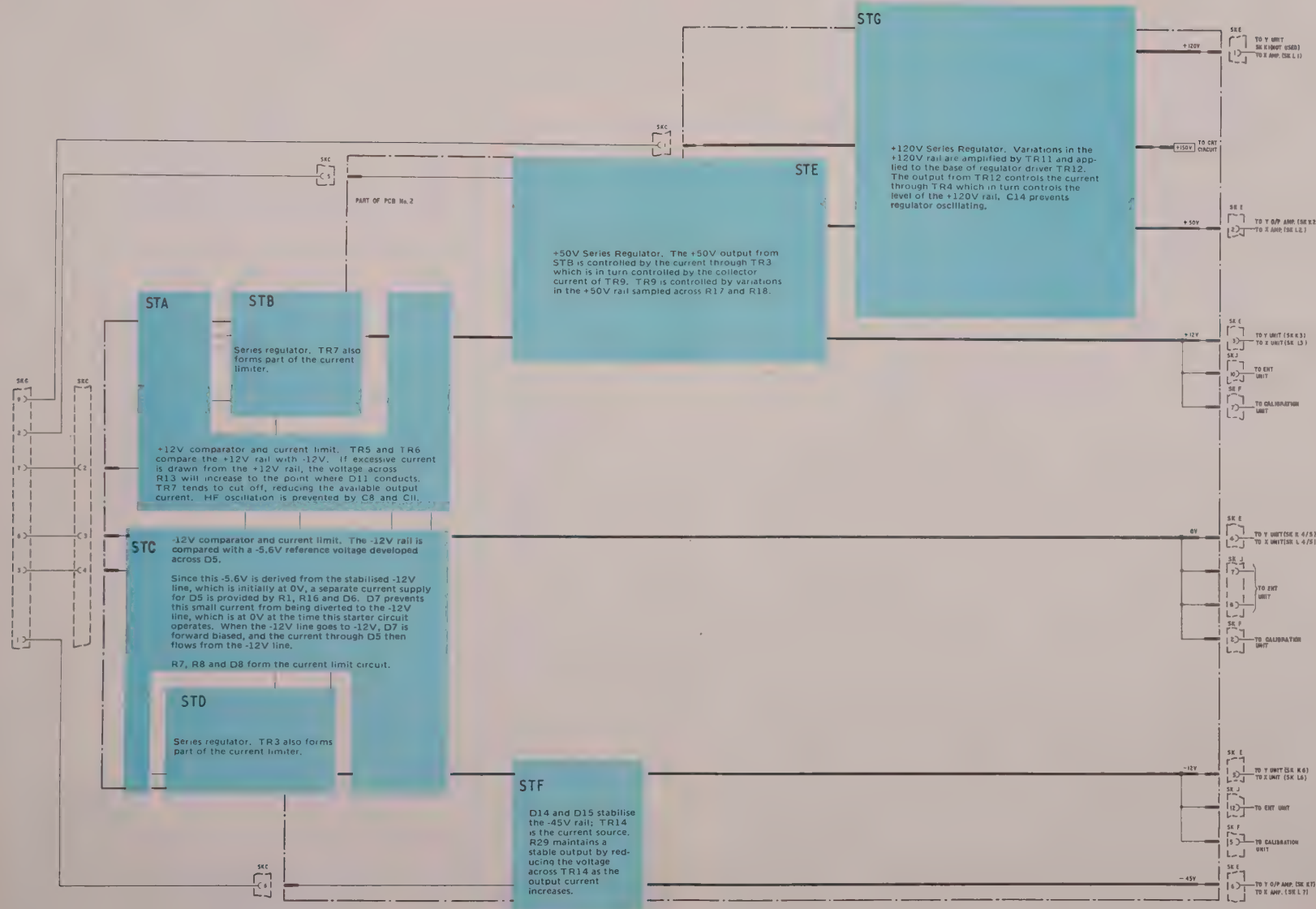


Fig. 8.4 A100 Main Frame Block Diagram



#### Procedure 100 Cal 1

Power supply voltages, ripple levels and regulation.

1. Ensure that X and Y modules are fitted.
2. Connect the instrument's mains lead to the output of the variac (test equipment item 4). Connect the variac to the mains and set its output to 215V or 240V, depending on the mains voltage selected in the oscilloscope. Switch on, and allow the instrument to warm up for 30 minutes.
3. Connect the DVM between earth and TP1 on pcb No. 2. Adjust RV1 to obtain a reading of  $-12V \pm 20mV$ .
4. Vary the instrument's mains input voltage between the limits 200-230V or 230-250V, depending on the selected mains voltage, and ensure that the DVM reading does not vary by more than 50mV.
5. Measure the ripple level of the -12V supply with the monitor oscilloscope, and ensure that it does not exceed 10mV peak-peak.
6. Measure the voltages and ripple levels of the +12V, +50V, +120V and -45V supplies, and ensure that they are within the limits specified in table 8.2 on page 8.9.

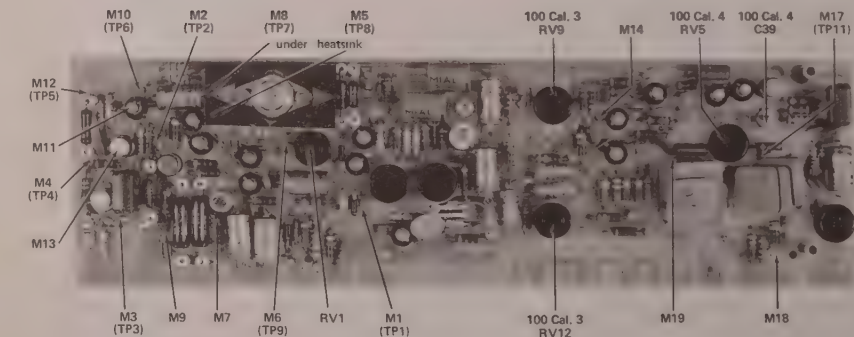


Fig. 8.6 PCB no.2



Fig. 8.7 PCB no. 2 (Component Side)

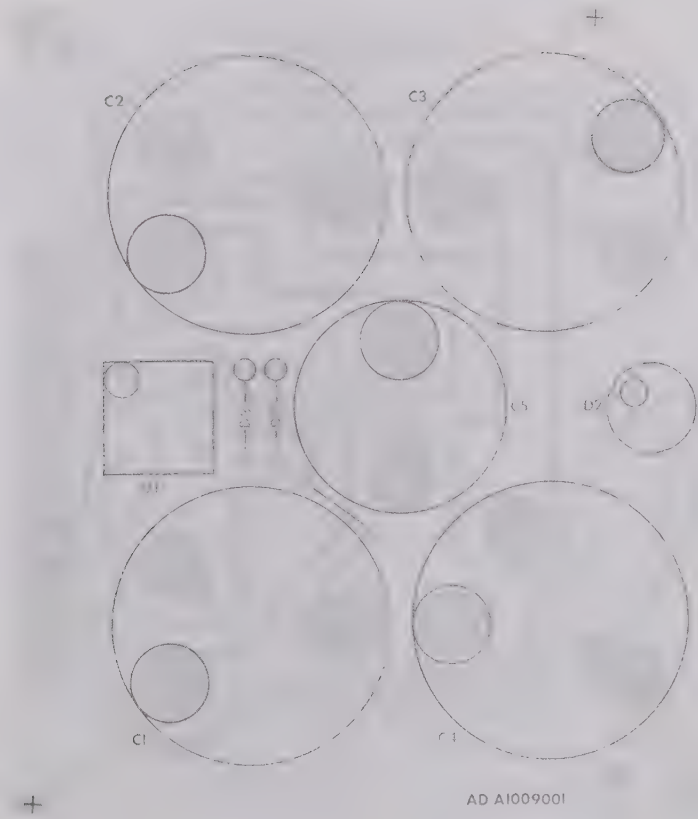


Fig. 8.8 PCB no. 1 (Component Side)

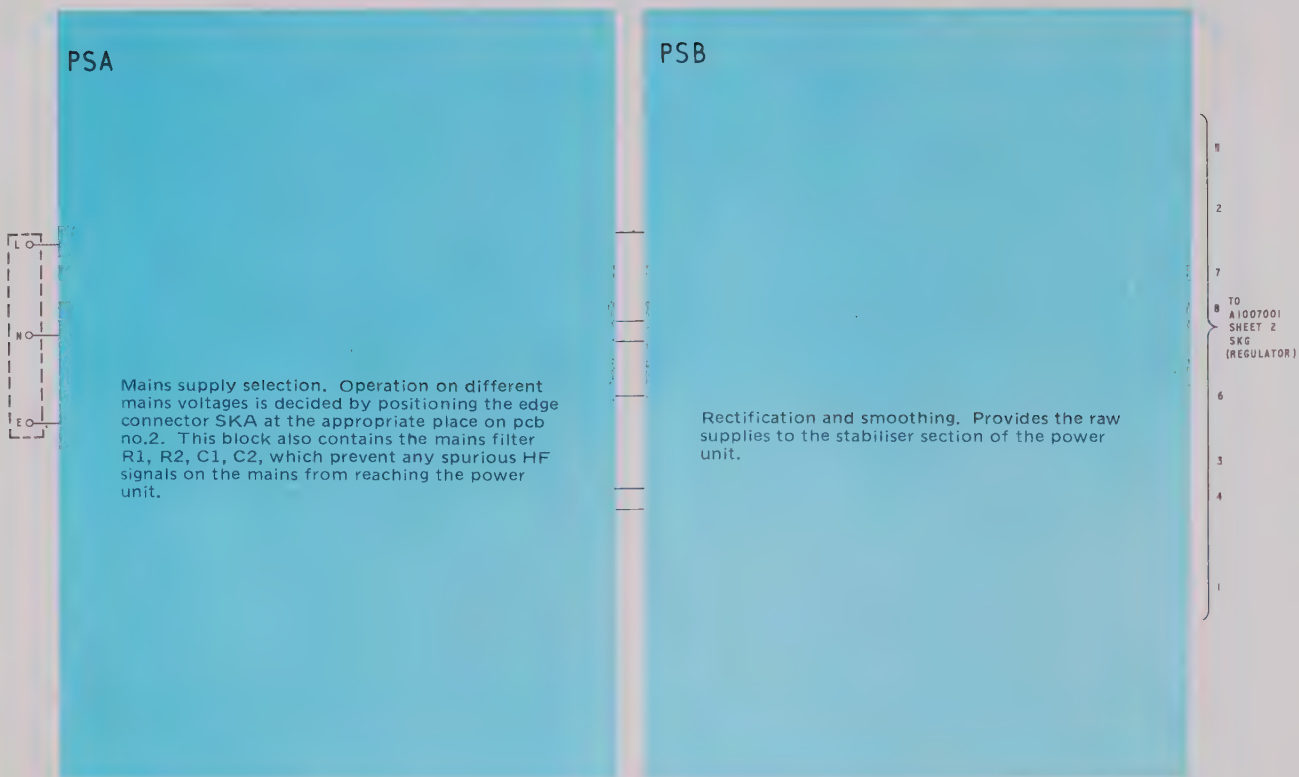


Fig. 8.9 Unregulated DC Supplies Block Diagram

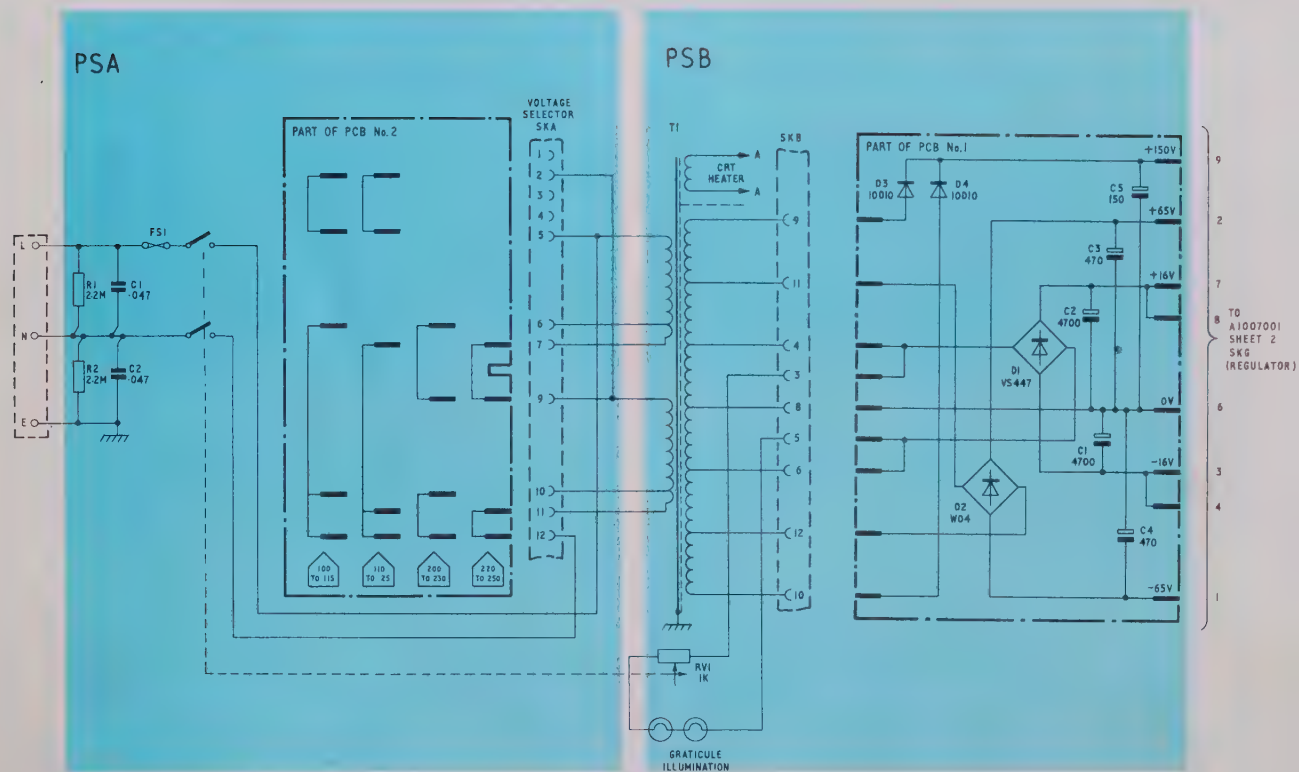


Fig. 8.10 Unregulated DC Supplies (DA1007001 Sht. 1)

Circuit Notes

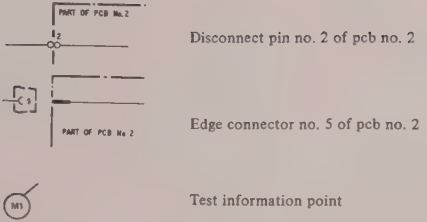


Table 8.2 Power Supplies Test Information M1 to M13

| Point     | Measurement wrt    | Maximum Ripple p-p wrt | Remarks      |
|-----------|--------------------|------------------------|--------------|
| M1 (TP1)  | -12V $\pm$ 20mV    | 10mV                   | -12V supply  |
| M2 (TP2)  | +11.65V to +12.55V | 10mV                   | +12V supply  |
| M3 (TP3)  | +48.5V to +55V     | 200mV                  | +50V supply  |
| M4 (TP4)  | +116V to +138V     | 2V                     | +120V supply |
| M5 (TP8)  | -43V to -50V       | 100mV                  | -45V supply  |
| M6 (TP9)  | -5.64V             |                        |              |
| M7        | -15.7V             |                        |              |
| M8 (TP7)  | +10.4mV            |                        |              |
| M9        | +17.4V             |                        |              |
| M10 (TP6) | +12.5V             |                        |              |
| M11       | +22.2V             |                        |              |
| M12 (TP5) | +52.5V             |                        |              |
| M13       | +129V              |                        |              |

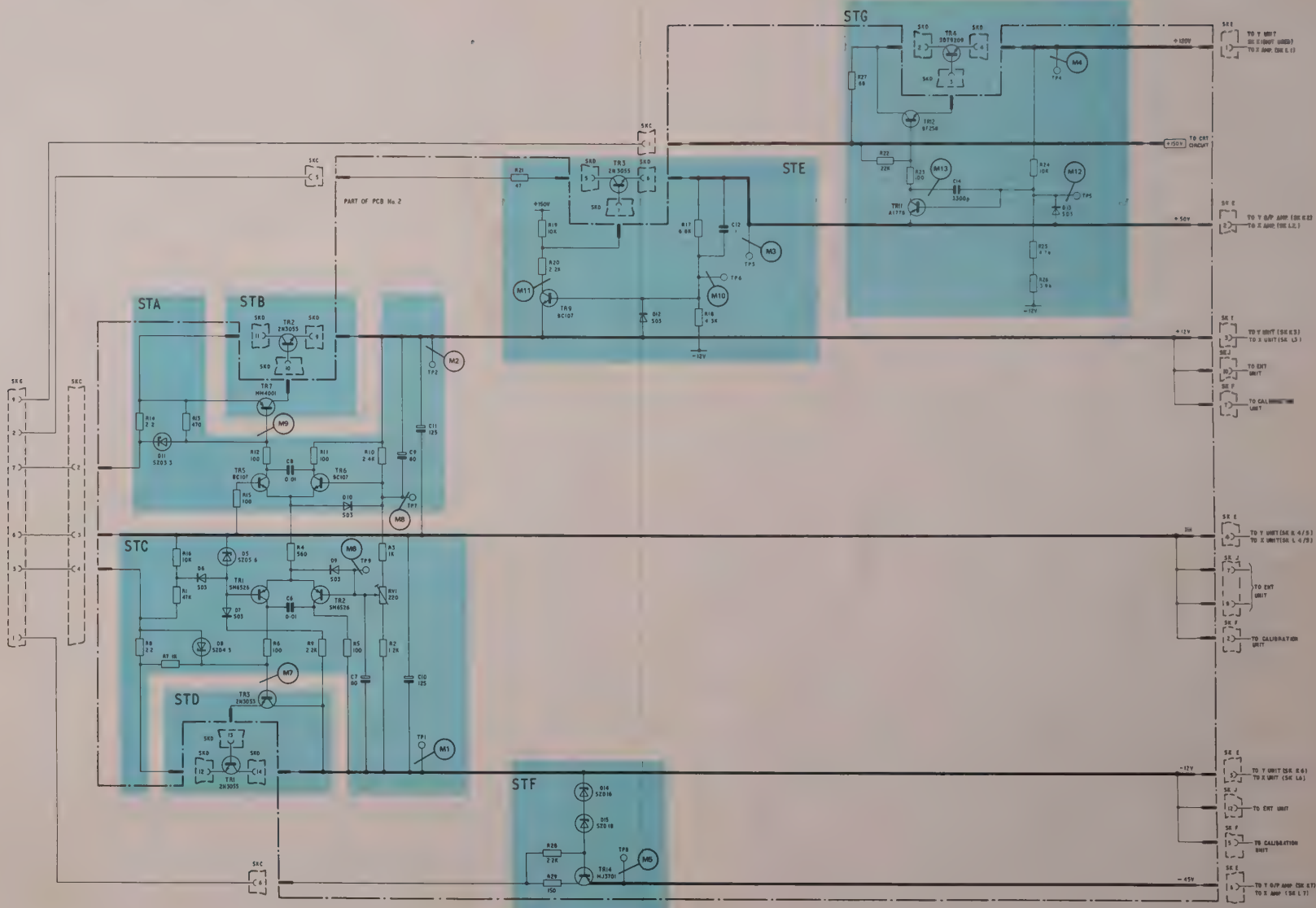
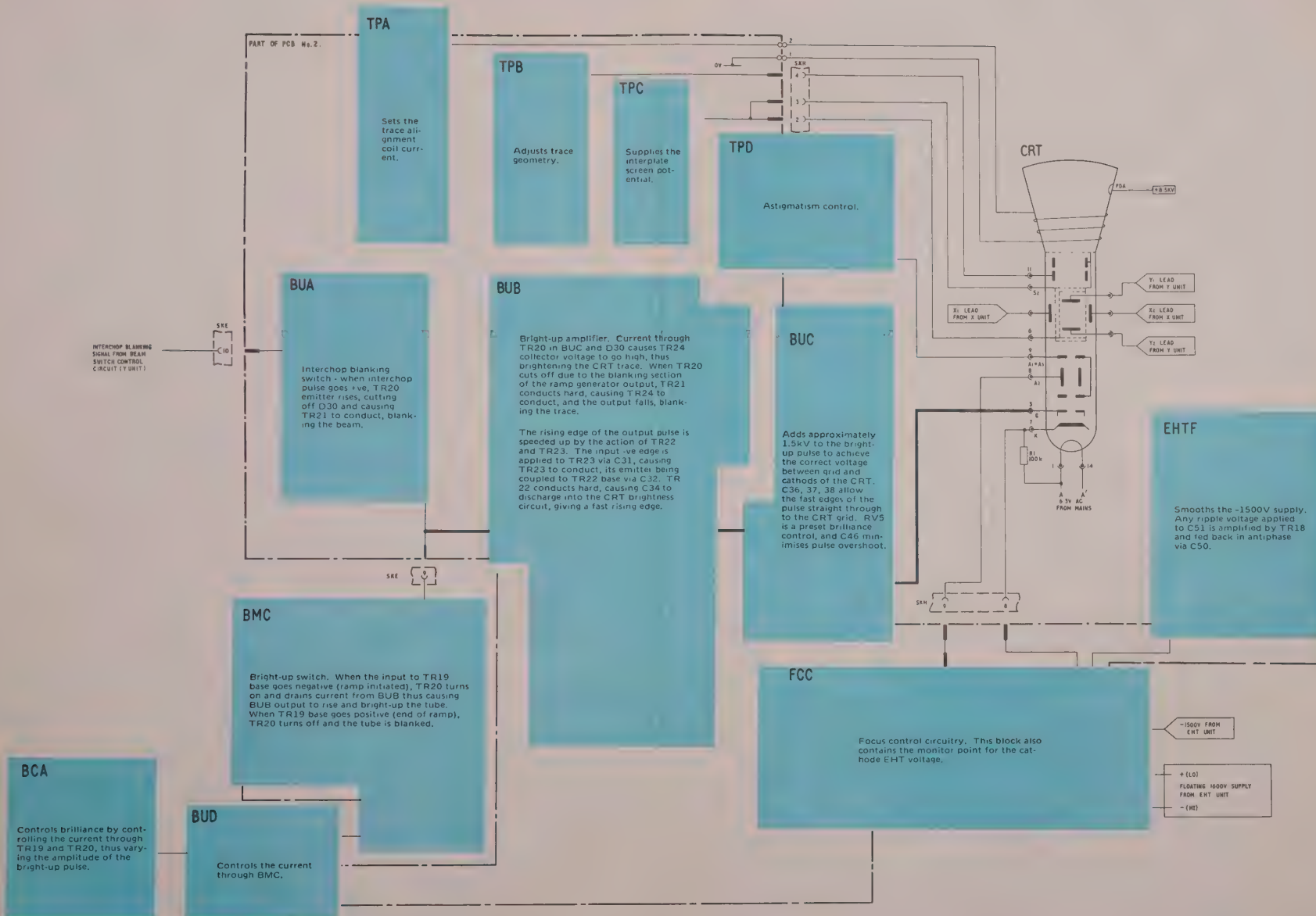


Fig. 8.11 Power Supply Stabilisers (DA1007001 Sht. 2)



#### Procedure 100 Cal 3

CRT trace alignment and geometry.

1. Obtain a single line trace. Adjust RV12 on pcb No. 2 to set the trace parallel to a horizontal graticule line.
2. Obtain a raster display. Adjust RV9 (GEOM) on pcb No. 2 to eliminate any pincushion or barrel distortion.

#### Procedure 100 Cal 4

Bright-up amplifier.

1. Obtain a single line trace. Select XY on the timebase switch; a single bright spot should now be displayed.
2. Set BRILL control approximately 90 degrees clockwise.
3. Adjust RV5 on pcb No. 2 for normal display brilliance.
4. Turn BRILL control slowly anticlockwise and check that the spot extinguishes before minimum control setting is reached. If not, readjust RV5.
5. Set TIME/CM to XY. Connect the DVM to TP11 on pcb No. 2. Turn FOCUS control fully anticlockwise to avoid damaging the CRT phosphor. Adjust BRILL control for a reading of 30V on the DVM with respect to chassis. Remove the DVM.
6. Set TIME/CM to 0.5μs/cm. Connect the Tektronix 106 fast-rise output to Y1 input via 50Ω in-line termination. Adjust generator amplitude for about 6cm picture.
7. Connect the monitor oscilloscope to TP11 via a 10MΩ probe. Adjust C39 on pcb No.2 for optimum square-wave with a risetime of not greater than 55ns.

Fig. 8.12 CRT and Bright-up Circuits Block Diagram

Fig. 8.13 PCB no. 2 (Component Side)

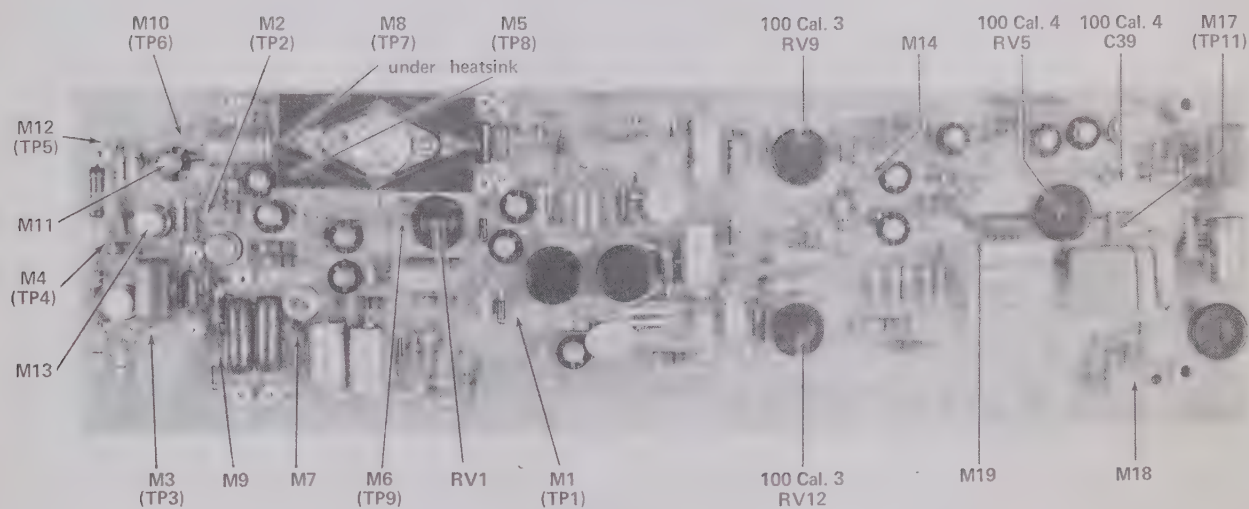
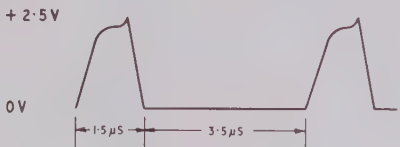
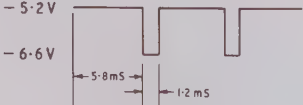
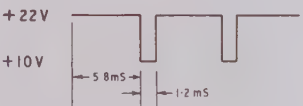


Fig. 8.14 PCB no. 2

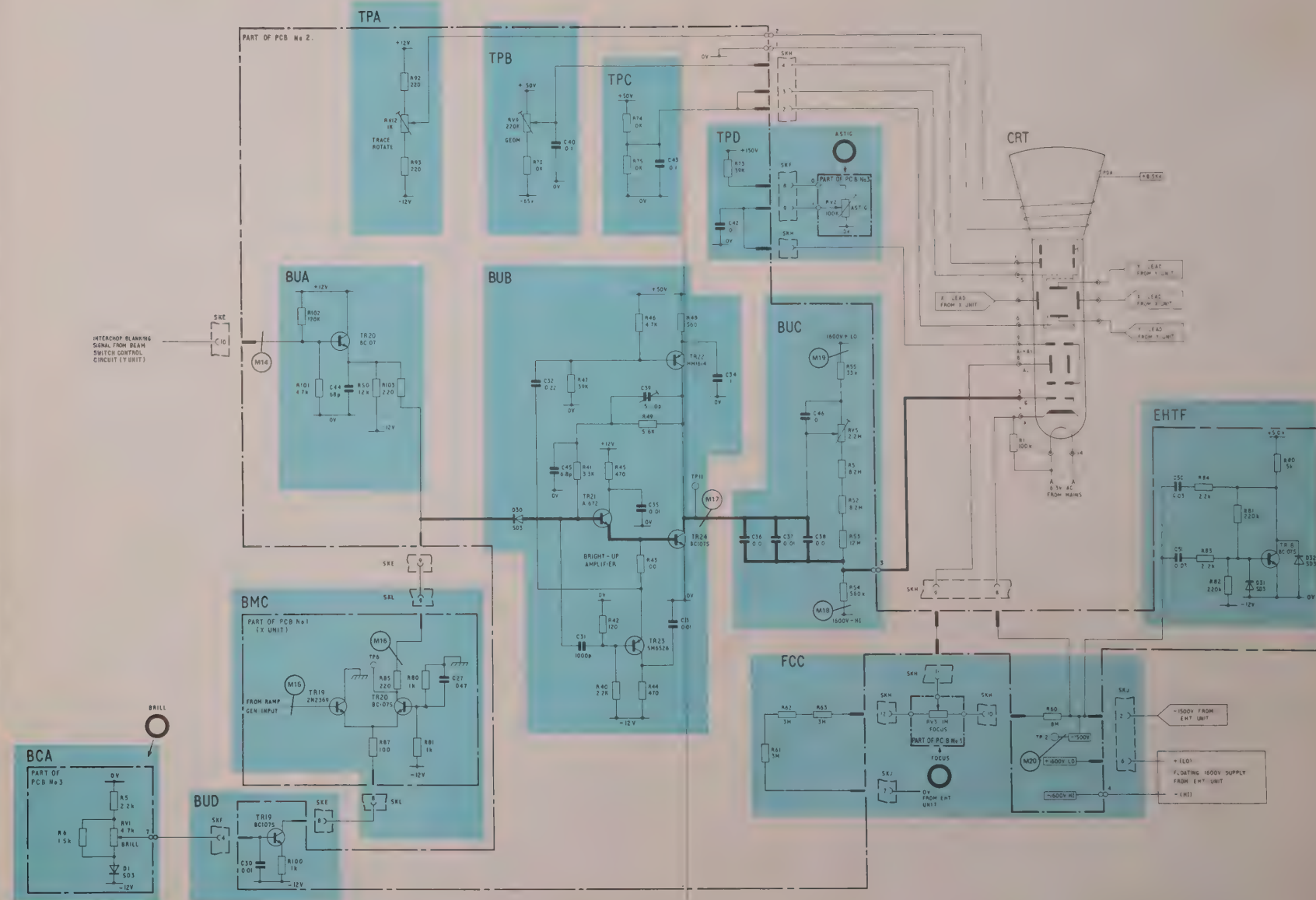
Table 8.3 Test Information Points M14 to M20 - CRT and Bright-Up

| Point                      | Measurement at Standard Settings                                                  | Remarks                                                                                       |
|----------------------------|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| M14                        |  |                                                                                               |
| M15                        |  | Observed at X unit. See A111 ramp generator or A112 'B' ramp generator circuits.              |
| M16                        |  |                                                                                               |
| M17<br>(TP11)              |  | This is the final bright-up signal before 1620 volts is added.                                |
| M18 (hi)<br>to<br>M19 (lo) | 1620V ± 5V<br>Ripple 1V p-p max.                                                  | Measure ripple between M18 and chassis with oscilloscope connected via a .01μF 2kV capacitor. |
| M20                        | -1500V ± 2V<br>Ripple 200mV p-p max.                                              | Measure ripple with oscilloscope connected via a .01μF 2kV capacitor.                         |

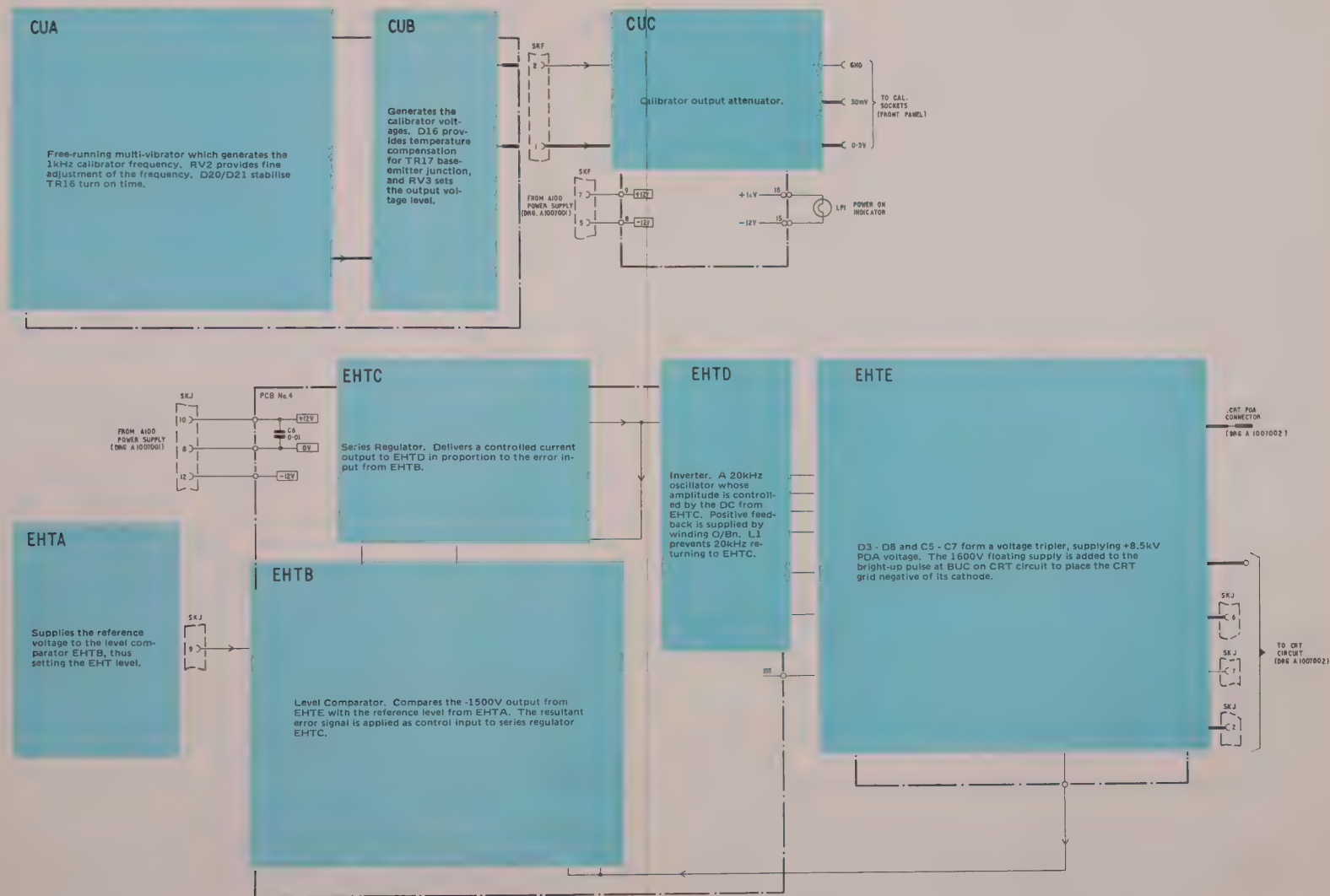


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On some models, R61 and R62 are 2.7M $\Omega$ , R63 is 3.3M $\Omega$ , and R60 is 1.8M $\Omega$ .



KCC A100/2



#### Procedure 100 Cal 2 EHT voltages and ripple levels.

1. Connect the DVM between chassis and TP12 on pcb No. 2. (TP12 is on Fig. 8.15 in block FCC). Adjust RV11 on pcb No. 2 for  $-1500V \pm 2V$ . Disconnect the DVM.
2. Connect a  $0.01\mu F$ , 2kV capacitor to TP12, and connect the monitor oscilloscope to the other leg of the capacitor. Measure the ripple; this should not exceed 200mV p-p.
3. Check the 1620V floating supply between points M18 (HI) and M19 (LO) as shown in table 8.3. on page 8-12.

#### Procedure 100 Cal 5 Calibrator

1. Connect the frequency counter to the calibrator 0.3V output. Adjust RV2 on pcb No. 2 for a reading of  $1kHz \pm 2Hz$ .
2. Remove TR15 (this is a plug-in transistor on pcb No. 2). Connect the DVM to the 0.3V output, and adjust RV3 on pcb No. 2 to obtain a reading of  $300mV \pm 1mV$ .
3. Transfer the DVM to the 30mV output. Check that the output is  $30mV \pm 0.6mV$ . If not, readjust RV3 to bring both outputs within specification.
4. Replace TR15.

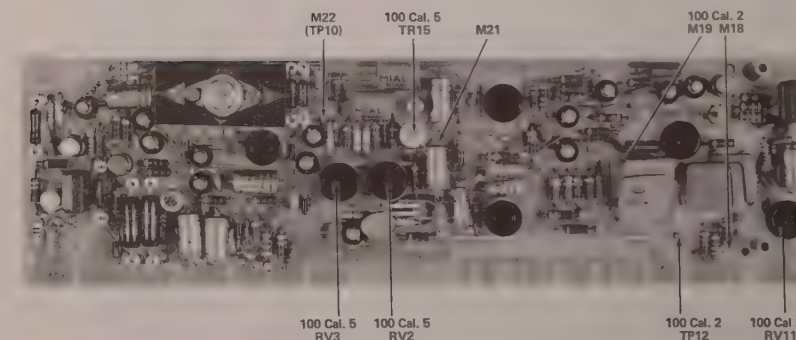


Fig. 8.17 PCB no. 2

Fig. 8.16 EHT Generator and Calibrator Block Diagram

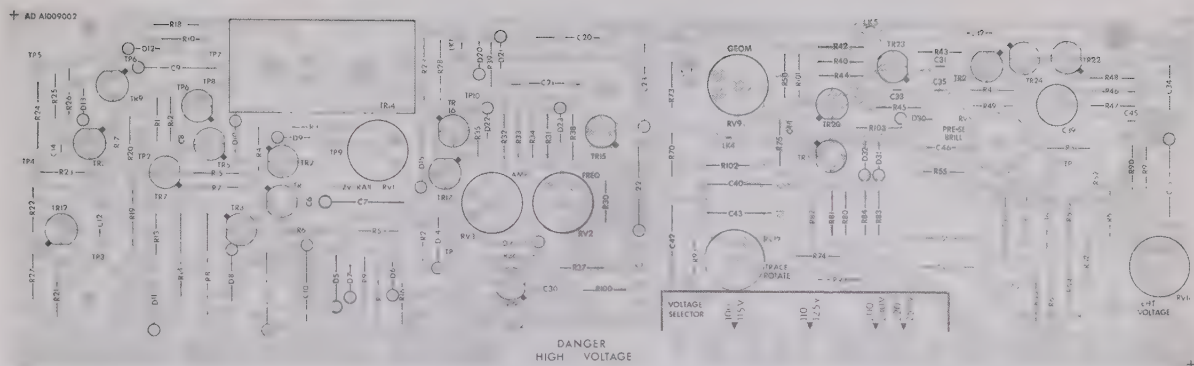


Fig. 8.18 PCB no. 2 (Component Side)

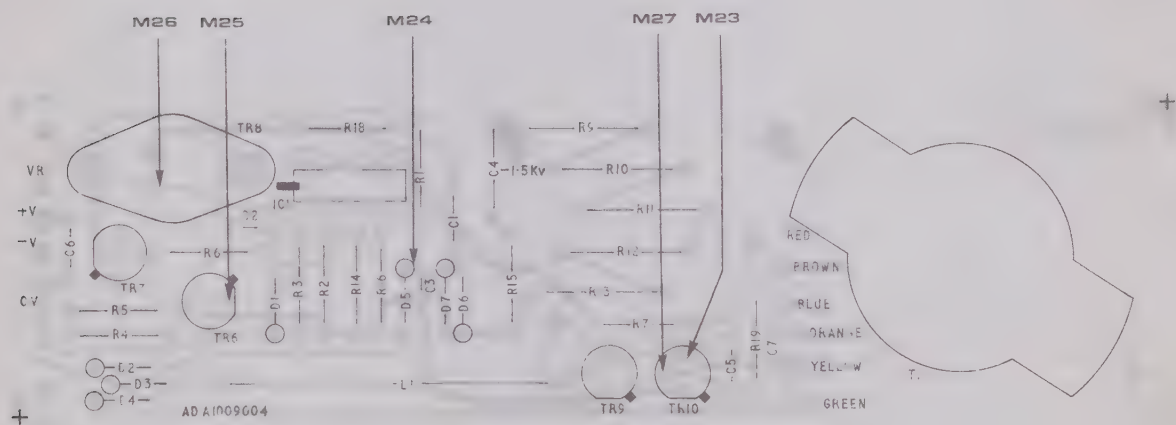


Fig. 8.19 PCB no. 4 (Copper Side)

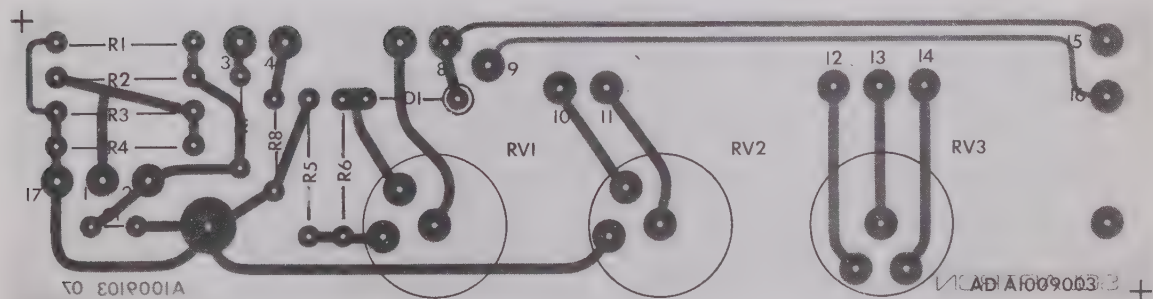
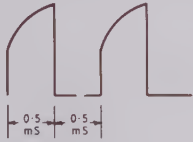
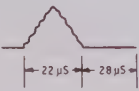
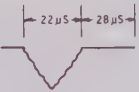


Fig. 8.20 PCB no. 5 (Component Side)

Table 8.4 Test Information M5 to M11 - Calibrator and EHT

| Point | Measurement at Standard Settings                                                                                                                      | Remarks                                          |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| M21   | -5.57V                                                                                                                                                |                                                  |
| M22   | <div><div>-1 V</div><div>-7 V</div><div>-12 V</div><div></div></div> |                                                  |
| M23   | <div><div>+20 V</div><div>+1 V</div><div></div></div>                | Points M23 to M27 are contained in the EHT unit. |
| M24   | -5.6V                                                                                                                                                 |                                                  |
| M25   | -0.6V                                                                                                                                                 |                                                  |
| M26   | +8.5V                                                                                                                                                 |                                                  |
| M27   | <div><div>+10.6 V</div><div>-3 V</div><div></div></div>             |                                                  |

# Circuit Notes



Disconnect pin no. 2 of pcb no. 2



Edge connector no. 5 of pcb no. 2



Test information point

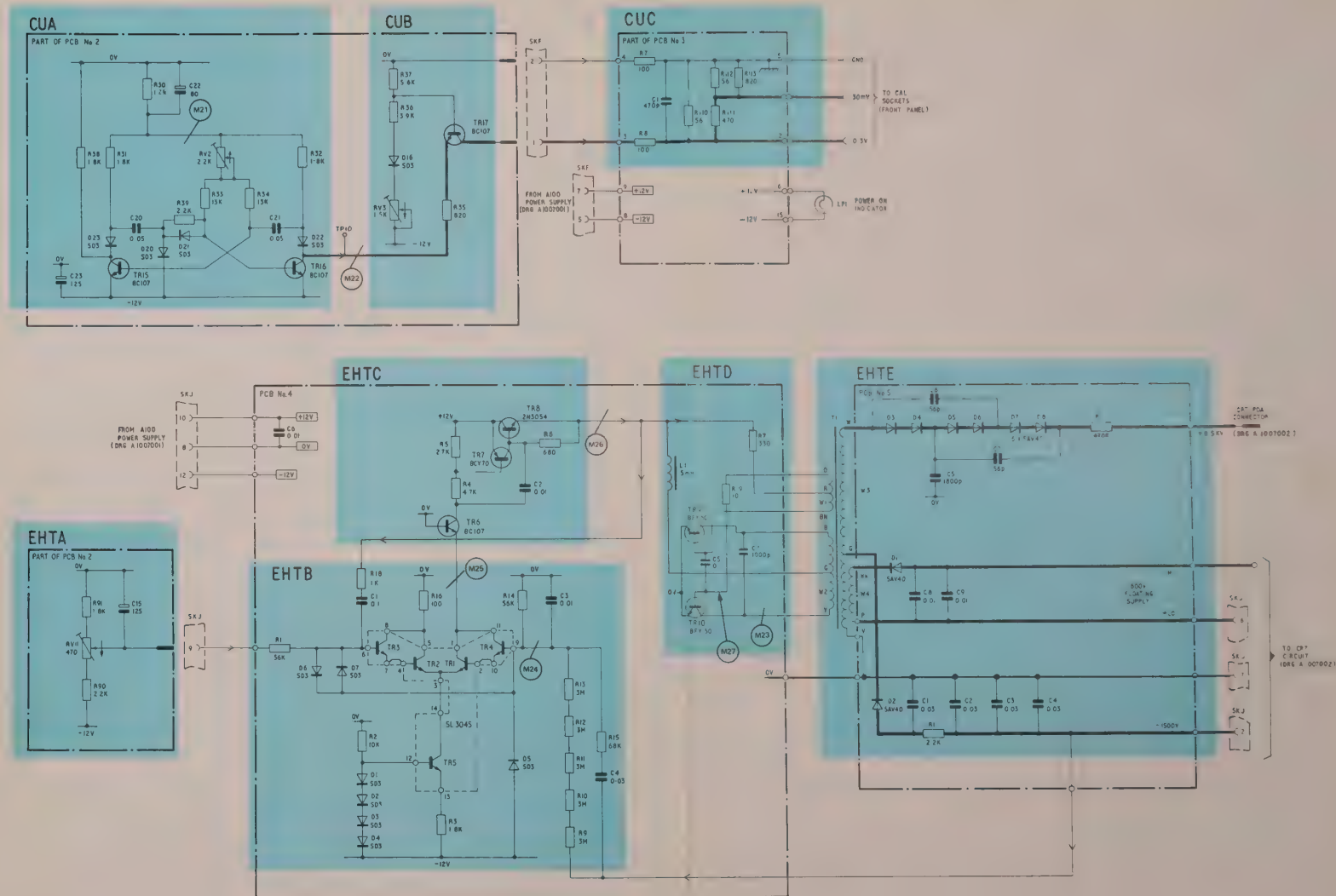


Fig. 8.21 EHT Generator and Calibrator (DA1007003)

COMPONENT PARTS LIST

ABBREVIATIONS

Circuit References

|     |                               |
|-----|-------------------------------|
| B   | Battery                       |
| C   | Capacitor (μF)                |
| CSR | Thyristor                     |
| D   | Diode                         |
| FS  | Fuse                          |
| IC  | Integrated Circuit            |
| L   | Inductor                      |
| LP  | Lamp (including Neon)         |
| LK  | Link                          |
| M   | Meter                         |
| MSP | Mains Selector Panel          |
| PL  | Plug                          |
| R   | Resistor (Ω)                  |
| RL  | Relay                         |
| S   | Switch                        |
| SK  | Socket                        |
| T   | Transformer                   |
| TP  | Terminal Post (or Test Point) |
| TR  | Transistor                    |
| V   | Valve                         |
| X   | Other Components              |

Also Used:-

|     |                         |
|-----|-------------------------|
| RNL | Non Linear Resistor (Ω) |
| RV  | Variable Resistor (Ω)   |

Component Composition

FIXED RESISTORS

|                       |      |
|-----------------------|------|
| Carbon Composition    | CACP |
| Carbon Film           | CAFM |
| Cracked Carbon        | CKCA |
| Metal Film            | MEFM |
| Metal Oxide           | MEOX |
| Power Wirewound       | POWW |
| Precision Wirewound   | PRWW |
| Temperature Sensitive | TEMP |
| Thick Film            | TKFM |
| Thin Film             | TNFM |
| Voltage Sensitive     | VOLT |

Component Composition (Cont'd)

VARIABLE RESISTORS

|                                   |      |
|-----------------------------------|------|
| Wirewound Preset Single Turn      | WWPS |
| Wirewound Preset Multiturn        | WWPM |
| Wirewound Front Panel Single Turn | WWFS |
| Wirewound Front Panel Multiturn   | WWFM |
| Carbon Preset Single Turn         | CAPS |
| Carbon Preset Multiturn           | CAPM |
| Carbon Front Panel Single Turn    | CAFS |
| Carbon Front Panel Multiturn      | CAFM |
| Cermet Preset Single Turn         | CMPS |
| Cermet Preset Multiturn           | CMPM |
| Cermet Front Panel Single Turn    | CMFS |
| Cermet Front Panel Multiturn      | CMFM |

CAPACITORS

|                        |      |
|------------------------|------|
| Air                    | AIR  |
| Aluminium Electrolytic | ALME |
| Aluminium Solid        | ALMS |
| Polycarbonate          | CARB |
| Ceramic                | CERM |
| Polyester Foil         | ESTF |
| Polyester Metallised   | ESTM |
| Glass                  | GLAS |
| Mica                   | MICA |
| Metallised Lacquer     | MLAC |
| Paper Foil             | PAPF |
| Paper Metallised       | PAPM |
| PTFE                   | PTFE |
| Polypropylene Film     | PYLN |
| Polystyrene            | STYR |
| Tantalum Dry           | TAND |
| Tantalum Foil          | TANF |
| Tantalum Wet           | TANW |

Column 4 indicates rating (Watts or Volts)  
Column 5 indicates tolerance (%)

Component Parts List  
for  
General Assembly

| Cct.<br>Ref. | General Description       |      |     |    |  | Solartron<br>Part No. |
|--------------|---------------------------|------|-----|----|--|-----------------------|
| R1           | CACP                      | 100k | .25 | 10 |  | 172351000             |
| RV10         | CAFS                      | 1k   | I   | 20 |  | 119600101             |
| LP1          | Pilot Lamp Assy.          |      |     |    |  | 300710700             |
| LP2          | Lamp Filament L.E.S. 12V  |      |     |    |  | 300710370             |
| LP3          | Lamp Filament L.E.S. 12V  |      |     |    |  | 300710370             |
| SKS          | Socket 2mm Black          |      |     |    |  | 352501590             |
| SKT          | Socket 2mm Black          |      |     |    |  | 352501590             |
| SKU          | Terminal 2mm Black        |      |     |    |  | 355001270             |
| V1           | Cathode Ray Tube with SKT |      |     |    |  | 300I00202             |

Component Parts List  
for  
Power Supply Assembly

| Cct.<br>Ref. | General Description |      |      |    |  | Solartron<br>Part No. |
|--------------|---------------------|------|------|----|--|-----------------------|
| R1           | CACP                | 2.2M | .25w | 10 |  | 172362200             |
| R2           | CACP                | 2.2M | .25w | 10 |  | 172362200             |

| Cct.<br>Ref. | General Description |      |      |    |  | Solartron<br>Part No. |
|--------------|---------------------|------|------|----|--|-----------------------|
| C1           | PAPM                | .047 | 630v | 20 |  | 208300050             |
| C2           | PAPM                | .047 | 630v | 20 |  | 208300050             |
| TR1          | 2N3055              |      |      |    |  | 300552340             |
| TR2          | 2N3055              |      |      |    |  | 300552340             |
| TR3          | 2N3055              |      |      |    |  | 300552340             |
| TR4          | SDT9209             |      |      |    |  | 300554020             |
| T1           | Transformer Mains   |      |      |    |  | 309600904             |

Component Parts List  
for  
EHT Generator

| Cct.<br>Ref. | General Description    |  |  |  |  | Solartron<br>Part No. |
|--------------|------------------------|--|--|--|--|-----------------------|
| T1           | EHT Transformer Bobbin |  |  |  |  | 309600705             |
| T1           | Ferrite Core           |  |  |  |  | 309010290             |

See also pcb no.4 and pcb no.5.

| Component Parts List |                     |              |     |    | Cct<br>Ref.           | General Description |       |      |            | Solartron<br>Part No. |
|----------------------|---------------------|--------------|-----|----|-----------------------|---------------------|-------|------|------------|-----------------------|
| for                  |                     |              |     |    |                       |                     |       |      |            |                       |
| PCB No.1 (A1009001)  |                     |              |     |    |                       |                     |       |      |            |                       |
|                      |                     |              |     |    | R41                   | MEOX                | 3.3k  | .5   | 1          | 195433300             |
|                      |                     |              |     |    | R42                   | CACP                | 120   | .25  | 10         | 172321200             |
|                      |                     |              |     |    | R43                   | CACP                | 100   | .25  | 10         | 172321000             |
|                      |                     |              |     |    | R44                   | CACP                | 470   | .25  | 10         | 172324700             |
| Cct.<br>Ref.         | General Description |              |     |    | Solartron<br>Part No. |                     |       |      |            |                       |
|                      |                     |              |     |    | R45                   | CACP                | 470   | .25  | 10         | 172324700             |
|                      |                     |              |     |    | R46                   | CACP                | 4.7k  | .25  | 10         | 172334700             |
|                      |                     |              |     |    | R47                   | CACP                | 39k   | .25  | 10         | 172343900             |
| C1                   | ALME                | 5000         |     |    | R48                   | CACP                | 560   | .25  | 10         | 172325600             |
| C2                   | ALME                | 5000         |     |    |                       |                     |       |      |            |                       |
| C3                   | ALME                | 500          |     |    |                       |                     |       |      |            |                       |
| C4                   | ALME                | 500          |     |    | R49                   | MEOX                | 5.6k  | .5   | 1          | 195435600             |
|                      |                     |              |     |    | R50                   | CACP                | 12k   | .25  | 10         | 172341200             |
|                      |                     |              |     |    | R51                   | CACP                | 8.2M  | .25  | 10         | 172368200             |
| C5                   | ALME                | 100          |     |    | R52                   | CACP                | 8.2M  | .25  | 10         | 172368200             |
|                      |                     |              |     |    |                       |                     |       |      |            |                       |
| D1                   | Rectifier Bridge    | Waycom VS447 |     |    | R53                   | CACP                | 12M   | .25  | 10         | 172371200             |
| D2                   | Rectifier Bridge    |              |     |    | R54                   | CACP                | 560k  | .25  | 10         | 172355600             |
| D3                   | Diode               |              |     |    | R55                   | CACP                | 33k   | .25  | 10         | 172343300             |
| D4                   | Diode               |              |     |    | R60                   | CACP                | 2.2M  | .25  | 10         | 172362200             |
|                      |                     |              |     |    |                       |                     |       |      |            |                       |
|                      |                     |              |     |    | R61                   | MEFM                | 3M    | .25  | 1          | 198363000             |
|                      |                     |              |     |    | R62                   | MEFM                | 3M    | .25  | 1          | 198363000             |
|                      |                     |              |     |    | R63                   | MEFM                | 3M    | .25  | 1          | 198363000             |
|                      |                     |              |     |    | R70                   | CACP                | 10k   | .25  | 10         | 172341000             |
|                      |                     |              |     |    |                       |                     |       |      |            |                       |
|                      |                     |              |     |    | R73                   | CACP                | 39k   | .25  | 10         | 172343900             |
|                      |                     |              |     |    | R74                   | CACP                | 10k   | .25  | 10         | 172341000             |
|                      |                     |              |     |    | R75                   | CACP                | 10k   | .25  | 10         | 172341000             |
|                      |                     |              |     |    | R80                   | CACP                | 15k   | .25  | 10         | 172341500             |
|                      |                     |              |     |    |                       |                     |       |      |            |                       |
|                      |                     |              |     |    | R81                   | CACP                | 220k  | .25  | 10         | 172352200             |
|                      |                     |              |     |    | R82                   | CACP                | 220k  | .25  | 10         | 172352200             |
|                      |                     |              |     |    | R83                   | CACP                | 2.2k  | .25  | 10         | 172332200             |
|                      |                     |              |     |    | R84                   | CACP                | 2.2k  | .25  | 10         | 172332200             |
|                      |                     |              |     |    |                       |                     |       |      |            |                       |
|                      |                     |              |     |    | R90                   | MEOX                | 2.2k  | .5   | 1          | 195432200             |
|                      |                     |              |     |    | R91                   | MEOX                | 1.8k  | .5   | 1          | 195431800             |
| Cct.<br>Ref.         | General Description |              |     |    | Solartron<br>Part No. |                     |       |      |            |                       |
|                      |                     |              |     |    | R92                   | CACP                | 220   | .25  | 10         | 172322200             |
|                      |                     |              |     |    | R93                   | CACP                | 220   | .25  | 10         | 172322200             |
| R1                   | CACP                | 47k          | .25 | 10 |                       |                     |       |      |            |                       |
| R2                   | MEOX                | 1.2k         | .5  | 1  |                       |                     |       |      |            |                       |
| R3                   | MEOX                | 1k           | .5  | 1  | R100                  | CACP                | 1k    | .25  | 10         | 172331000             |
| R4                   | CACP                | 560          | .25 | 10 | R101                  | CACP                | 4.7k  | .25  | 10         | 172334700             |
|                      |                     |              |     |    | R102                  | CACP                | 120k  | .25  | 10         | 172351200             |
|                      |                     |              |     |    | R103                  | CACP                | 220   | .25  | 10         | 172322200             |
| R5                   | CACP                | 100          | .25 | 10 |                       |                     |       |      |            |                       |
| R6                   | CACP                | 100          | .25 | 10 |                       |                     |       |      |            |                       |
| R7                   | CACP                | 1k           | .25 | 10 | RV1                   | WWPS                | 220   | 1    | 10         | 110037230             |
| R8                   | POWW                | 2.2          | 3   | 5  | RV2                   | CAPS                | 2.2k  | .25  | 10         | 136632200             |
|                      |                     |              |     |    | RV3                   | CAPS                | 1k    | .25  | 20         | 136631000             |
|                      |                     |              |     |    | RV5                   | CAPS                | 2.2M  | .25  | 20         | 136662200             |
| R9                   | CACP                | 2.2k         | .25 | 10 |                       |                     |       |      |            |                       |
| R10                  | MEOX                | 2.4k         | .5  | 1  |                       |                     |       |      |            |                       |
| R11                  | CACP                | 100          | .25 | 10 | RV9                   | CAPS                | 220k  | .25  | 20         | 136652200             |
| R12                  | CACP                | 100          | .25 | 10 | RV11                  | CAPS                | 470   | .25  | 20         | 136624700             |
|                      |                     |              |     |    | RV12                  | WWPS                | 1k    | 1    | 20         | 110027220             |
| R13                  | CACP                | 470          | .25 | 10 |                       |                     |       |      |            |                       |
| R14                  | POWW                | 2.2          | 3   | 5  |                       |                     |       |      |            |                       |
| R15                  | CACP                | 100          | .25 | 10 | C6                    | CERM                | .01   | 25   | -20<br>+80 | 241941000             |
| R16                  | CACP                | 10k          | .25 | 10 | C7                    | ALME                | 80    | 25   | -10<br>+50 | 208600230             |
| R17                  | MEOX                | 6.8k         | .5  | 1  |                       |                     |       |      |            |                       |
| R18                  | MEOX                | 4.3k         | .5  | 1  | C8                    | CERM                | .01   | 25   | -20<br>+80 | 241941000             |
| R19                  | POWW                | 10k          | 1.5 | 5  |                       |                     |       |      |            |                       |
| R20                  | CACP                | 2.2k         | .25 | 10 | C9                    | ALME                | 80    | 25   | -10<br>+50 | 208600230             |
|                      |                     |              |     |    |                       |                     |       |      |            |                       |
| R21                  | MEOX                | 47           | .5  | 5  |                       |                     |       |      |            |                       |
| R22                  | CACP                | 22k          | .25 | 10 | C10                   | ALME                | 125   | 16   | -10<br>+50 | 208600220             |
| R23                  | CACP                | 100          | .25 | 10 |                       |                     |       |      |            |                       |
| R24                  | MEOX                | 10k          | 1   | 1  | C11                   | ALME                | 125   | 16   | -10<br>+50 | 208600220             |
|                      |                     |              |     |    |                       |                     |       |      |            |                       |
| R25                  | MEOX                | 4.7k         | .5  | 1  | C12                   | ESTM                | 1     | 100  | 10         | 225461000             |
| R26                  | MEOX                | 3.9k         | .5  | 1  | C14                   | CERM                | 3300p | 500  | 20         | 241333300             |
| R27                  | MEOX                | 100          | .5  | 5  |                       |                     |       |      |            |                       |
| R28                  | POWW                | 2.2k         | 1.5 | 5  |                       |                     |       |      |            |                       |
|                      |                     |              |     |    | C15                   | ALME                | 125   | 16   | -10<br>+50 | 208600220             |
| R29                  | POWW                | 150          | 1.5 | 5  |                       |                     |       |      |            |                       |
| R30                  | CACP                | 1.2k         | .25 | 10 | C20                   | STYR                | .05   | 63   | 2.5        | 208100160             |
| R31                  | CACP                | 1.8k         | .25 | 10 | C22                   | ALME                | 80    | 25   | -10<br>+50 | 208600230             |
| R32                  | CACP                | 1.8k         | .25 | 10 |                       |                     |       |      |            |                       |
|                      |                     |              |     |    | C23                   | ALME                | 125   | 16   | -10<br>+50 | 208600220             |
|                      |                     |              |     |    |                       |                     |       |      |            |                       |
| R33                  | MEOX                | 13k          | .5  | 1  |                       |                     |       |      |            |                       |
| R34                  | MEOX                | 13k          | .5  | 1  |                       |                     |       |      |            |                       |
| R35                  | MEOX                | 820          | .5  | 1  |                       |                     |       |      |            |                       |
| R36                  | MEOX                | 3.9k         | .5  | 1  | C30                   | CERM                | 0.1   | 30   | -25<br>+50 | 242051000             |
|                      |                     |              |     |    |                       |                     |       |      |            |                       |
|                      |                     |              |     |    | C31                   | CERM                | 1000p | 500V | 20         | 241331000             |
| R37                  | MEOX                | 5.6k         | .5  | 1  | C32                   | ESTM                | .22   | 100V | 10%        | 225452200             |
| R38                  | CACP                | 1.8k         | .25 | 10 | C33                   | CERM                | .01   | 25V  | -25<br>+50 | 241949000             |
| R39                  | CACP                | 2.2k         | .25 | 10 |                       |                     |       |      |            |                       |
| R40                  | CACP                | 2.2k         | .25 | 10 | C34                   | ESTM                | 1     | 100V | 10         | 225461000             |

| Cct.<br>Ref.                                                | General Description |        |       |     |  | Solartron<br>Part No. | Cct.<br>Ref.                                                | General Description           |       |      |     |  | Solartron<br>Part No. |
|-------------------------------------------------------------|---------------------|--------|-------|-----|--|-----------------------|-------------------------------------------------------------|-------------------------------|-------|------|-----|--|-----------------------|
| C35                                                         | CERM                | .01    | 25V   | -25 |  | 241941000             | R5                                                          | CACP                          | 2.2k  | .25  | 10  |  | 172332200             |
| C36                                                         | CERM                | .01    | 2kV   | +50 |  | 208450005             | R6                                                          | CACP                          | 1.5k  | .25  | 10  |  | 172331500             |
| C37                                                         | CERM                | .01    | 2kV   | -20 |  | 208450005             | R7                                                          | CACP                          | 100   | .125 | 10  |  | 172021000             |
| C38                                                         | CERM                | .01    | 2kV   | +80 |  | 208450005             | R8                                                          | CACP                          | 100   | .125 | 10  |  | 172021000             |
| C39                                                         | CERM                | 1.5/5p | 50V   | -20 |  | 290030220             | RV1                                                         | CAFS                          | 4.7k  | .25  | 20  |  | 110010095             |
| C40                                                         | ESTM                | .1     | 160V  | +80 |  | 220351000             | RV2                                                         | CAFS                          | 100k  | .25  | 20  |  | 110010174             |
| C42                                                         | ESTM                | .1     | 160V  | -20 |  | 220351000             | RV3                                                         | CAFS                          | 1M    | .25  | 20  |  | 110010208             |
| C43                                                         | ESTM                | .1     | 160V  | +80 |  | 220351000             | C1                                                          | CERM                          | 470p  | 500V | 20  |  | 241324700             |
| C44                                                         | CERM                | 68p    | 500V  | 10  |  | 241316800             | D1                                                          | Diode SD3                     |       |      |     |  | 300522160             |
| C45                                                         | CERM                | 6.8p   | 500V  | 10  |  | 241306800             |                                                             |                               |       |      |     |  |                       |
| C46                                                         | ESTM                | 0.1    | 100V  | 10  |  | 225451000             |                                                             |                               |       |      |     |  |                       |
| C50                                                         | CERM                | .03    | 1.5kV | -20 |  | 208450003             |                                                             |                               |       |      |     |  |                       |
|                                                             |                     |        |       | +80 |  |                       |                                                             |                               |       |      |     |  |                       |
| C51                                                         | CERM                | .03    | 1.5kV | -20 |  | 208450003             |                                                             |                               |       |      |     |  |                       |
|                                                             |                     |        |       | +80 |  |                       |                                                             |                               |       |      |     |  |                       |
| D5                                                          | Diode Zener 5.6V    |        |       |     |  | 300521450             | <b>Component Parts List<br/>for<br/>PCB No.4 (A1009004)</b> |                               |       |      |     |  |                       |
| D6                                                          | Diode SD3           |        |       |     |  | 300522160             |                                                             |                               |       |      |     |  |                       |
| D7                                                          | Diode SD3           |        |       |     |  | 300522160             |                                                             |                               |       |      |     |  |                       |
| D8                                                          | Diode Zener 4.3V    |        |       |     |  | 300523900             |                                                             |                               |       |      |     |  |                       |
| D9                                                          | Diode SD3           |        |       |     |  | 300522160             |                                                             |                               |       |      |     |  |                       |
| D10                                                         | Diode SD3           |        |       |     |  | 300522160             | Cct.<br>Ref.                                                | General Description           |       |      |     |  | Solartron<br>Part No. |
| D11                                                         | Diode Zener 3.3V    |        |       |     |  | 300521860             | R1                                                          | CACP                          | 56k   | .25  | 10  |  | 172345600             |
| D12                                                         | Diode SD3           |        |       |     |  | 300522160             | R2                                                          | CACP                          | 10k   | .25  | 10  |  | 172341000             |
| D13                                                         | Diode SD3           |        |       |     |  | 300522160             | R3                                                          | CACP                          | 1.8k  | .25  | 10  |  | 172331800             |
| D14                                                         | Diode Zener 16V     |        |       |     |  | 300521320             | R4                                                          | CACP                          | 4.7k  | .25  | 10  |  | 172334700             |
| D15                                                         | Diode Zener 18V     |        |       |     |  | 300521300             | R5                                                          | CACP                          | 2.7k  | .25  | 10  |  | 172332700             |
| D16                                                         | Diode SD3           |        |       |     |  | 300522160             | R6                                                          | CACP                          | 680   | .25  | 10  |  | 172326800             |
| D20                                                         | Diode SD3           |        |       |     |  | 300522160             | R7                                                          | CACP                          | 330   | .25  | 10  |  | 172323300             |
| D21                                                         | Diode SD3           |        |       |     |  | 300522160             | R9                                                          | MEFM                          | 3M    | .25  | 1   |  | 198363003             |
| D22                                                         | Diode SD3           |        |       |     |  | 300522160             | R10                                                         | MEFM                          | 3M    | .25  | 1   |  | 198363003             |
| D23                                                         | Diode SD3           |        |       |     |  | 300522160             | R11                                                         | MEFM                          | 3M    | .25  | 1   |  | 198363003             |
| D30                                                         | Diode SD3           |        |       |     |  | 300522160             | R12                                                         | MEFM                          | 3M    | .25  | 1   |  | 198363003             |
| D31                                                         | Diode SD3           |        |       |     |  | 300522160             | R13                                                         | MEFM                          | 3M    | .25  | 1   |  | 198363003             |
| D32                                                         | Diode SD3           |        |       |     |  | 300522160             | R14                                                         | MEOX                          | 56k   | .5   | 1   |  | 195445600             |
| TR1                                                         | Transistor SM6526   |        |       |     |  | 300552990             | R15                                                         | CACP                          | 68k   | .25  | 10  |  | 172346800             |
| TR2                                                         | Transistor SM6526   |        |       |     |  | 300552990             | R16                                                         | CACP                          | 100   | .25  | 10  |  | 172321000             |
| TR3                                                         | Transistor 2N3053   |        |       |     |  | 300551800             | R18                                                         | CACP                          | 1k    | .25  | 10  |  | 172331000             |
| TR5                                                         | Transistor BC107S   |        |       |     |  | 300553320             | R19                                                         | CACP                          | 10    | .25  | 10  |  | 172311000             |
| TR6                                                         | Transistor BC107S   |        |       |     |  | 300553320             | C1                                                          | ESTM                          | .1    | 100  | 10  |  | 225451000             |
| TR7                                                         | Transistor MM4001   |        |       |     |  | 300554050             | C2                                                          | CERM                          | .01   | 25   | -25 |  | 241941000             |
| TR9                                                         | Transistor BC107S   |        |       |     |  | 300553320             |                                                             |                               |       |      | +50 |  |                       |
| TR11                                                        | Transistor A1778    |        |       |     |  | 300551430             | C3                                                          | CERM                          | .01   | 25   | -25 |  | 241941000             |
| TR12                                                        | Transistor BF258    |        |       |     |  | 300554120             |                                                             |                               |       |      | +50 |  |                       |
| TR14                                                        | Transistor MJ3701   |        |       |     |  | 300554380             | C4                                                          | CERM                          | .03   | 1500 | -20 |  | 208450003             |
| TR15                                                        | Transistor BC107S   |        |       |     |  | 300553320             |                                                             |                               |       |      | +80 |  |                       |
| to<br>TR20                                                  |                     |        |       |     |  |                       | C5                                                          | CERM                          | .1    | 30   | -20 |  | 242051000             |
| TR21                                                        | Transistor A1672    |        |       |     |  | 300551910             |                                                             |                               |       |      | +80 |  |                       |
| TR22                                                        | Transistor MM1614   |        |       |     |  | 300551670             | C6                                                          | CERM                          | .01   | 25   | -25 |  | 241941000             |
| TR23                                                        | Transistor SM6526   |        |       |     |  | 300552990             |                                                             |                               |       |      | +50 |  |                       |
| TR24                                                        | Transistor BC107S   |        |       |     |  | 300553320             | C7                                                          | CERM                          | 1000p | 500V | 20  |  | 241331000             |
|                                                             |                     |        |       |     |  |                       | D1<br>to<br>D7                                              | Diode SD3                     |       |      |     |  | 300522160             |
| <b>Component Parts List<br/>for<br/>PCB No.3 (A1009003)</b> |                     |        |       |     |  |                       | TR1                                                         | 5 transistor D.I.L. Package   |       |      |     |  | 300554090             |
|                                                             |                     |        |       |     |  |                       | TR2                                                         | 5 transistor D.I.L. Package   |       |      |     |  | 300554090             |
|                                                             |                     |        |       |     |  |                       | TR3                                                         | 5 transistor D.I.L. Package   |       |      |     |  | 300554090             |
|                                                             |                     |        |       |     |  |                       | TR4                                                         | 5 transistor D.I.L. Package   |       |      |     |  | 300554090             |
|                                                             |                     |        |       |     |  |                       | TR5                                                         | 5 transistor D.I.L. Package   |       |      |     |  | 300554090             |
| Cct<br>Ref                                                  | General Description |        |       |     |  | Solartron<br>Part No. | TR6                                                         | Transistor Silicon NPN BC107S |       |      |     |  | 300553320             |
| R1                                                          | MEOX                | 56     | .5    | 1   |  | 195415600             | TR7                                                         | Transistor Silicon PNP BCY70  |       |      |     |  | 300553590             |
| R2                                                          | MEOX                | 470    | .5    | 1   |  | 195424700             | TR8                                                         | Transistor Silicon NPN 2N3054 |       |      |     |  | 300552060             |
| R3                                                          | MEOX                | 56     | .5    | 1   |  | 195415600             | TR9                                                         | Transistor Silicon NPN BFY50  |       |      |     |  | 300553610             |
| R4                                                          | CACP                | 820    | .25   | 10  |  | 172328200             | TR10                                                        | Transistor Silicon NPN BFY50  |       |      |     |  | 300553610             |
|                                                             |                     |        |       |     |  |                       | L1                                                          | Inductor                      |       |      |     |  | 309500301             |

**Component Parts List**  
for  
**PCB No.5 (A1009005)**

| Cct.<br>Ref. | General Description |       |      |     | Solartron<br>Part No. |
|--------------|---------------------|-------|------|-----|-----------------------|
| R1           | CACP                | 2.2k  | .25W | 1   | 172332200             |
| R2           | CACP                | 470k  | .25W | 1   | 172354700             |
| C1           | CERM                | .03   | 1500 | -20 | 208450003             |
|              |                     |       |      | +80 |                       |
| C2           | CERM                | .03   | 1500 | -20 | 208450003             |
|              |                     |       |      | +80 |                       |
| C3           | CERM                | .03   | 1500 | -20 | 208450003             |
|              |                     |       |      | +80 |                       |
| C4           | CERM                | .03   | 1500 | -20 | 208450003             |
|              |                     |       |      | +80 |                       |
| C5           | CERM                | 1800p | 4000 | -20 | 208450014             |
|              |                     |       |      | +80 |                       |
| C6           | CERM                | 56p   | 8000 | -20 | 208450118             |
|              |                     |       |      | +80 |                       |
| C7           | CERM                | 56p   | 8000 | -20 | 208450118             |
|              |                     |       |      | +80 |                       |
| C8           | CERM                | .01   | 2000 | -20 | 208450005             |
|              |                     |       |      | +80 |                       |
| C9           | CERM                | .01   | 2000 | -20 | 208450005             |
|              |                     |       |      | +80 |                       |
| D1           | Diode Silicon EHT   |       |      |     | 300524930             |
| D2           | Diode Silicon EHT   |       |      |     | 300524930             |
| D3           | Diode Silicon EHT   |       |      |     | 300524930             |
| D4           | Diode Silicon EHT   |       |      |     | 300524930             |
| D5           | Diode Silicon EHT   |       |      |     | 300524930             |
| D6           | Diode Silicon EHT   |       |      |     | 300524930             |
| D7           | Diode Silicon EHT   |       |      |     | 300524930             |
| D8           | Diode Silicon EHT   |       |      |     | 300524930             |



# SECTION 9 Dual Trace Y Amplifier A101

## Outline Description (refer to block diagram, Fig. 9.1)

The A101 is a dual-trace Y amplifier of 30MHz bandwidth at 5mV/cm sensitivity per channel. It employs beam switching techniques to achieve the dual-trace facility; this allows conversion of the unit to a differential mode amplifier by simple switching.

Most of the signal amplification is performed by three special integrated circuits. The first-stage integrated circuit in each channel also performs the beam-switching, gain switching, shift and DC balance functions. The trigger signal is taken from another output on the first-stage integrated circuit.

The second stage integrated circuit, which is identical to the other two, provides a current output to feed a common-base amplifier which drives the CRT Y plates. This stage also provides HF compensation to achieve the amplifier's 30MHz bandwidth.

The sensitivity selector gives the standard 1,2,5 sequence of sensitivities from 5mV/cm to 20V/cm. The attenuator proper operates in decade steps, the intermediate sensitivities being achieved by altering the gain of the first signal amplifier stage.

The basic sensitivity of the Y1 amplifier can be multiplied by 10, giving an overall sensitivity of 0.5mV/cm at 2.5MHz bandwidth. This is achieved by amplifying the input signal by a factor of 9 and applying it in antiphase to the inverting (or 'signal low') input, giving an overall amplification of 10.

## Outline Calibration Procedures (see page 7.2)

For a full calibration, adjustments should be made in the order given in table 9.1 below. The procedure requires a calibrated timebase unit, A111 or A112. If a complete oscilloscope is to be calibrated, the X sensitivity must first be adjusted before procedure 101 Cal 4 is performed.

Table 9.1 A101 Calibration

| Procedure | Description                                  | Test Equipment Required* |
|-----------|----------------------------------------------|--------------------------|
| 101 Cal 1 | Step attenuator and variable gain balancing. |                          |
| 101 Cal 2 | Output amplifier centering                   |                          |
| 101 Cal 3 | Gain ratio adjustment                        | 1                        |
| 101 Cal 4 | Y amplifier gain                             | 1                        |
| 101 Cal 5 | X10 amplifier gain                           | 1                        |
| 101 Cal 6 | Step attenuator adjustments                  | 2, 4                     |
| 101 Cal 7 | HF pulse response                            | 3, 4                     |

\* See page 9.2

Test Equipment Requirements

| Item | Description                         | Minimum Specification            | Suggested Instrument |
|------|-------------------------------------|----------------------------------|----------------------|
| 1    | Oscilloscope calibrator             |                                  | Bradley 192 or 156   |
| 2    | Capacitance meter                   | 25-30pF                          | Tektronix 130        |
| 3    | Constant amplitude signal generator | 50kHz - 40MHz                    | Tektronix 191        |
| 4    | Pulse generator                     | 120V at 10kHz known leading edge | Tektronix 106        |

Servicing Information

Waveforms monitored at test information points Y1 to Y7 are all square waves: the information given consists of the mean DC level as measured on a digital voltmeter and the peak-to-peak AC voltage as measured on an oscilloscope.

The beam switch waveforms (Y8 to Y11) are not all square waves, and representative traces have been given.

Standard Settings

The waveforms and voltages at the measuring points in this instrument were taken from a serviceable instrument with the controls set as follows:

|                       |                      |
|-----------------------|----------------------|
| Sensitivity Y1 and Y2 | 50mV/cm              |
| Variable gain         | CAL                  |
| Input coupling        | AC                   |
| Mode                  | Y1                   |
| Trigger               | Y1                   |
| Y1 Shift              | Centralised trace    |
| X10                   | OUT                  |
| -Y2                   | OUT                  |
| Input signal          | 0.3V from calibrator |

Mechanical

Removal of Melamine Front Panel

This is necessary for adjustments to the attenuator compensation capacitors. Proceed as follows:-

- 1. Remove module. (see page 7.2)
- 2. Remove knobs on attenuators, variable gain controls, Y-shift controls and input coupling lever switch.
- 3. Carefully lever off melamine panel. It is secured by four press-fit nylon studs, which will come away with the panel.

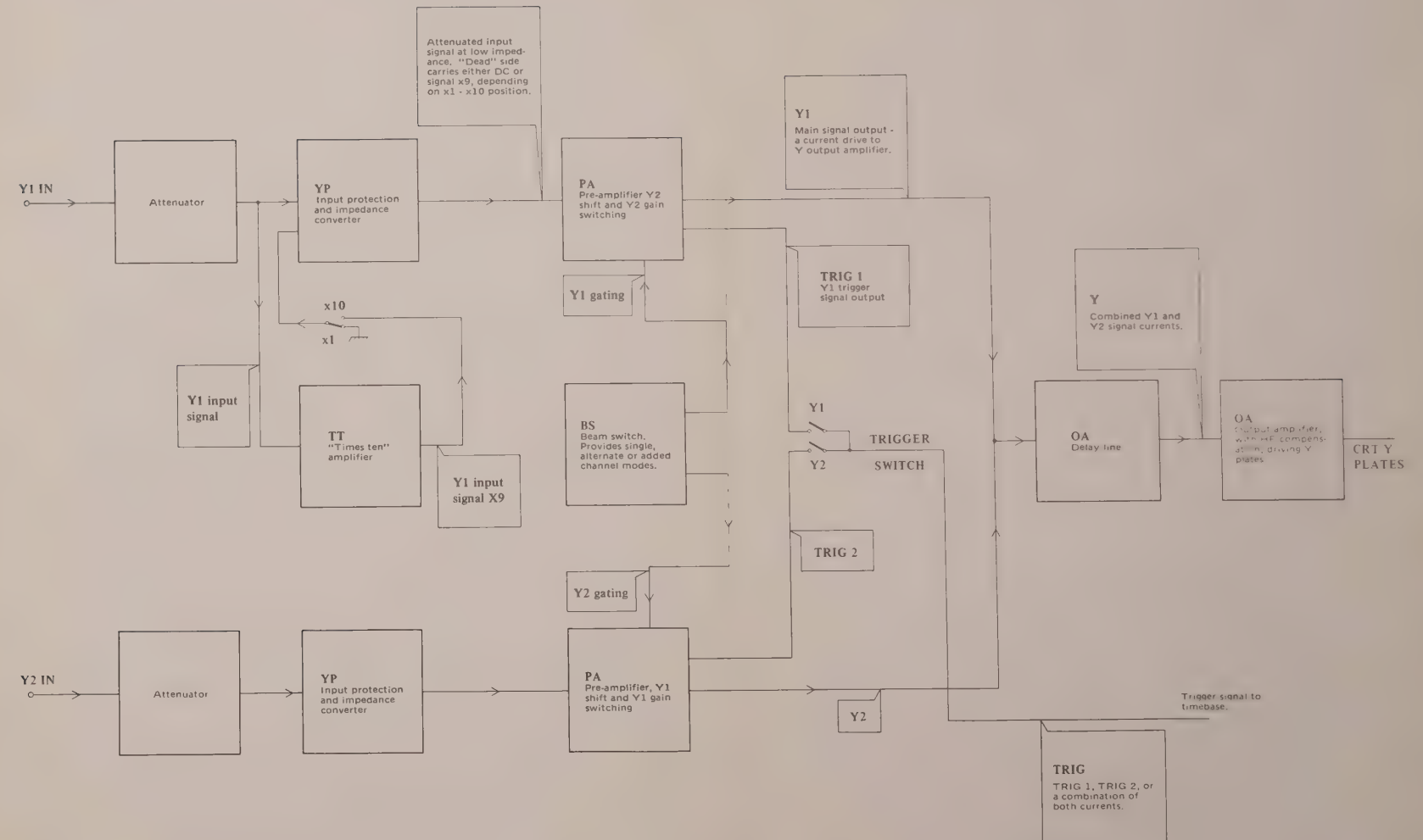


Fig. 9.1 A101 Block Diagram

## Procedure 101 Cal 6

### Step attenuator adjustments.

Both attenuators are identical; only Y1 will be described. Before starting adjustments, the melamine front panel must be removed (see page 9.2). Also remove the plastic main frame section covering Y1 C6 and Y2 C9 (see Fig. 9.2).

1. Set TIME/CM on timebase to  $50\mu\text{s}$ , set Y1 sensitivity to  $100\text{mV/cm}$ . Apply  $10\text{kHz}$  square wave from Tektronix 106 to Y1 input. Set amplitude for a 6cm picture approximately.
2. Adjust  $\div 10$  trimmer (C11) for optimum square wave.
3. Set Y1 sensitivity to  $1\text{V/cm}$ , readjust generator for a 6cm picture, and adjust  $\div 100$  trimmer (C8) for optimum square wave.
4. Repeat for  $10\text{V/cm}$ , adjust  $\div 1000$  trimmer (C5).
5. Apply capacitance meter to Y1 input. Refer to Fig. 9.2 for input capacitor locations.
6. Set sensitivity to  $5\text{mV/cm}$  and adjust C2 for  $28\text{pF}$  reading.
7. Set sensitivity to  $50\text{mV/cm}$  and adjust C9 for  $28\text{pF}$  reading.
8. Set sensitivity to  $500\text{mV/cm}$  and adjust C6 for  $28\text{pF}$  reading.
9. Set sensitivity to  $5\text{V/cm}$  and adjust C3 for  $28\text{pF}$  reading.
10. Repeat paras. 1-4; if any readjustment is needed, repeat paras. 5-9.
11. Repeat paras. 1-10 for Y2.



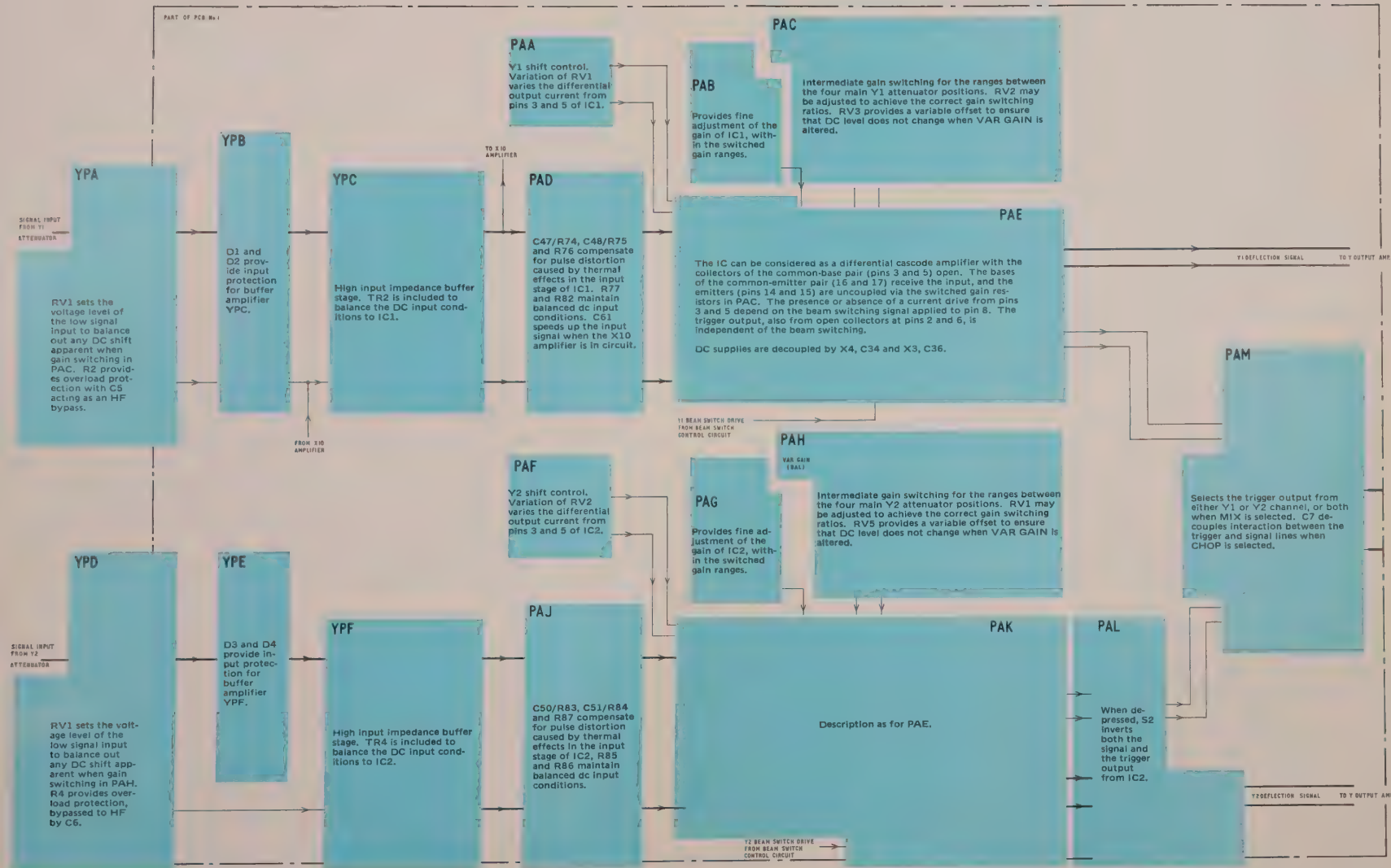


Fig. 9.5 Pre-amplifiers Block Diagram

#### Procedure 101 Cal 1

Step attenuator and variable gain balancing.

The procedures for Y1 and Y2 attenuators are identical; where applicable, Y2 adjustments are in brackets.

1. Obtain a single line trace on Y1 (Y2) channel.
2. Set Y1 (Y2) sensitivity selector to 20mV/cm and adjust Y1 (Y2) shift to centralise the trace vertically.
3. Set sensitivity selector to 50mV/cm and adjust Y1 BAL (Y2 BAL) preset control RV1 to re-centre the trace.
4. Re-adjust BAL control, as necessary, so that the trace does not shift when the sensitivity selector is changed between 20mV/cm and 50mV/cm.
5. Adjust RV3 (RV5) on pcb No. 1 to obtain minimum vertical shift of the trace when the variable gain control is rotated over its full range. Trace movement when balanced should be less than 2mm.
6. Repeat above adjustments for Y2.

#### Procedure 101 Cal 3

Gain ratio adjustment.

Procedures for Y1 and Y2 are identical; adjustments for Y2 are given in brackets.

1. Set Y1 (Y2) variable gain control to CAL. Set sensitivity to 0.2V/cm.
2. Inject a 1kHz signal of 1V amplitude from Bradley 192 or 156 into Y1 (Y2) input.
3. Adjust Y1 CAL (Y2 CAL) preset control for a 5cm picture.
4. Reduce the input signal to 250mV. Change the sensitivity to 50mV/cm.
5. Adjust RV2 (RV4) on pcb No. 1 for a 5cm picture.
6. Repeat paras. 1 - 5 until both sensitivities are within specification.
7. Repeat paras. 1-6 for Y2.

#### Procedure 101 Cal 4

Y amplifier gain.

1. On timebase unit, set TIME/CM to XY and trigger selector to INT. On A101, select Y2 mode and Y1 trigger; the instrument is now set up for XY operation with the horizontal signal on the Y1 input and the vertical signal on Y2 input.
2. Set Y1 sensitivity to 5mV/cm and apply 1kHz at 30mV from Bradley 192 or 156 or from the internal calibrator. Two horizontally opposed spots will now be displayed.
3. Adjust Y1 shift for minimum horizontal movement of spots when trigger coupling switch on timebase is moved between AC and DC.

4. Adjust Y1 CAL preset control to position the spots 6cm apart.
5. Switch TIME/CM to 0.5ms; select Y1 mode on A101.
6. Adjust RV7 (shown on circuit diagram Fig. 9.14) on A101 pcb No. 1 for a 6cm picture.
7. Transfer 30mV input signal to Y2 input. Set Y2 sensitivity to 5mV/cm and fine gain control to CAL.
8. Adjust Y2 CAL preset control for a 6 cm picture.

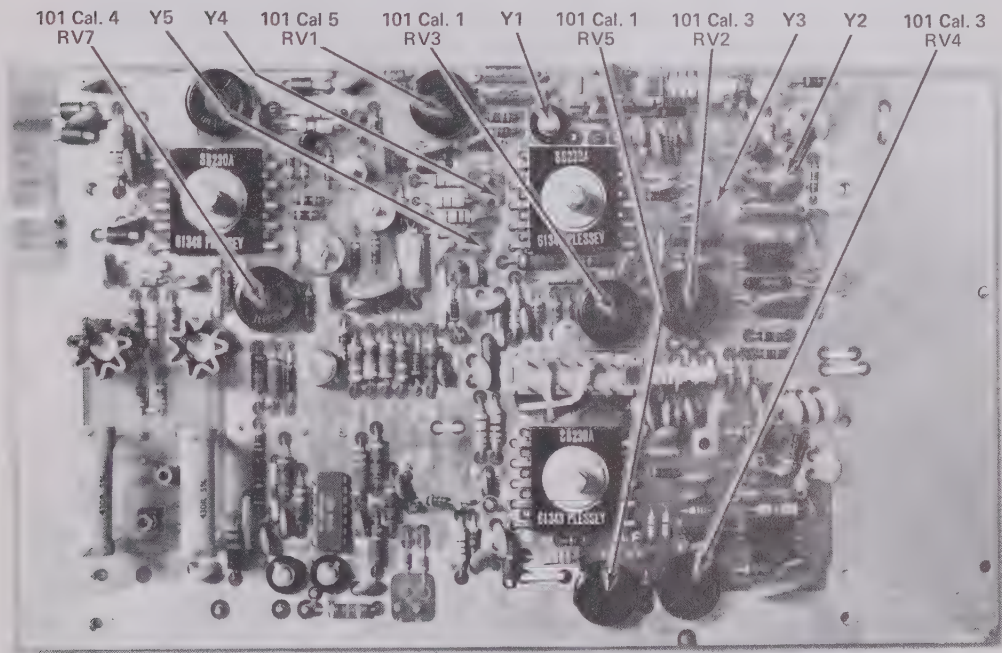


Fig. 9.6 PCB no. 1 (Attenuators, Switches and Heatsinks Removed)

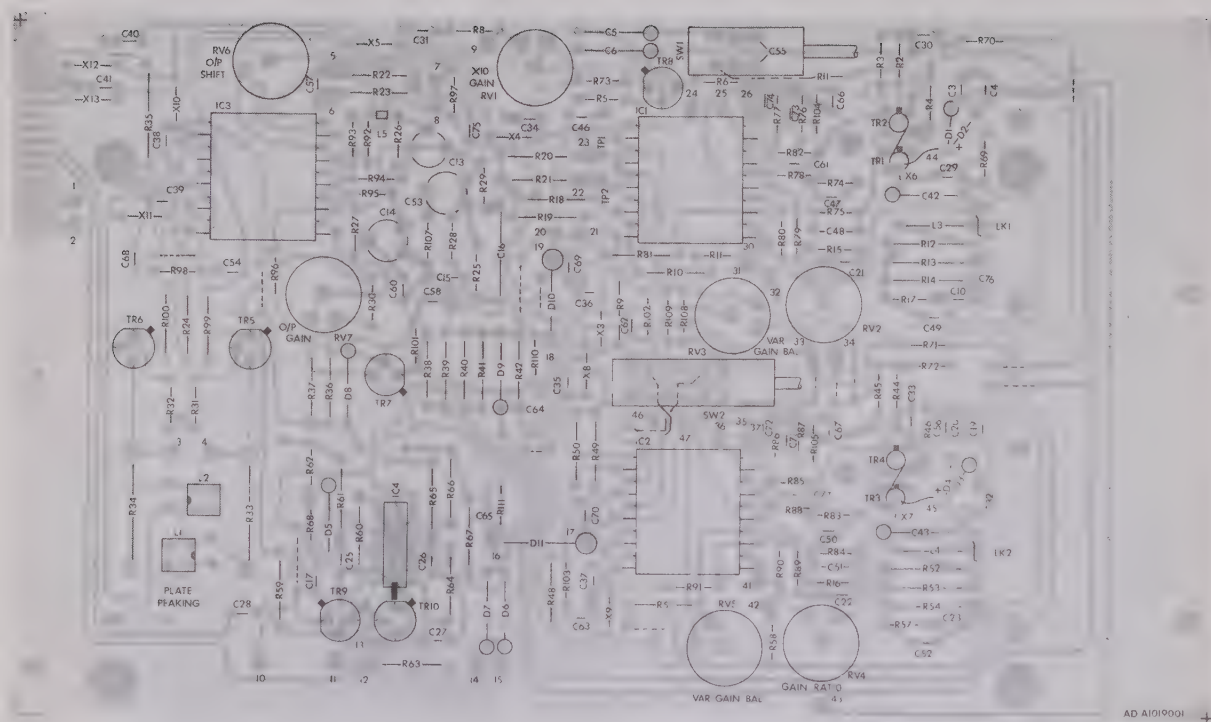


Fig. 9.7 PCB no. 1 (Component Side)

### Procedure 101 Cal 5

X10 amplifier gain.

1. Set Y1 sensitivity to 5mV/cm and variable gain control to CAL. Inject 30mV signal into Y1 input from Bradley 192 or 156.
2. Adjust Y1 shift to position trace on the centre 6cm of screen.
3. Reduce input signal to 3mV, select X10.
4. Adjust RV1 on pcb No. 1 to obtain a 6cm picture.

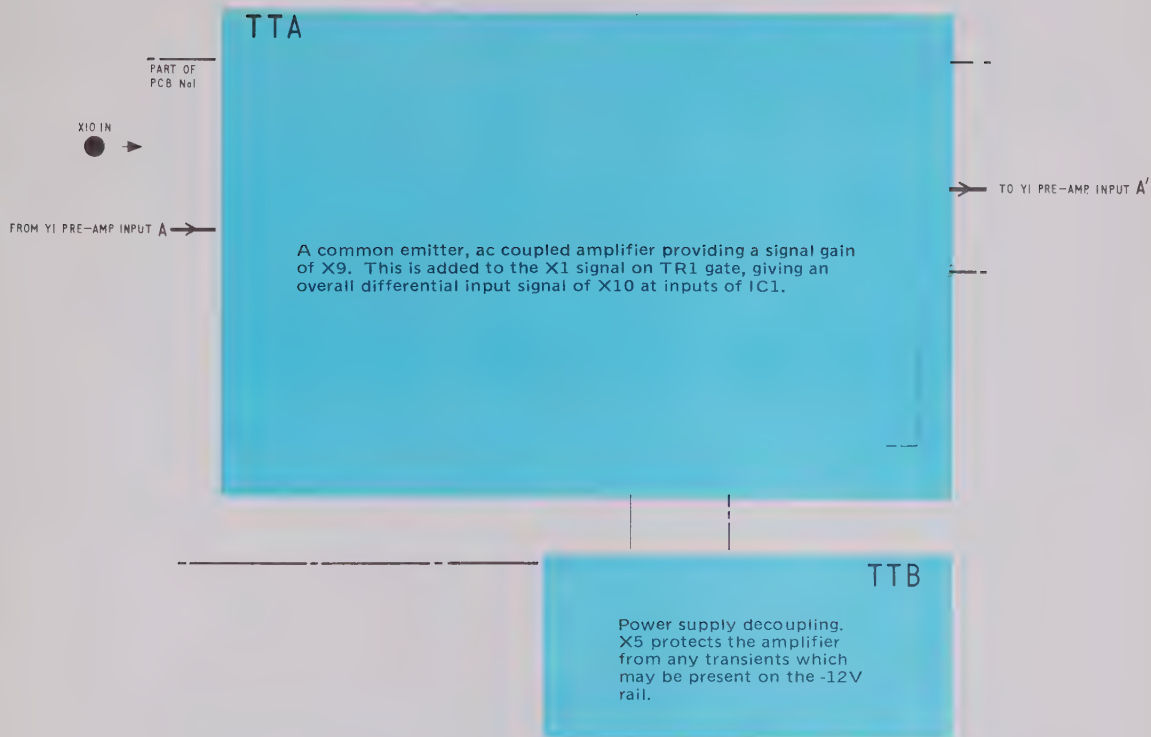


Fig. 9.8 Times Ten Amplifier Block Diagram

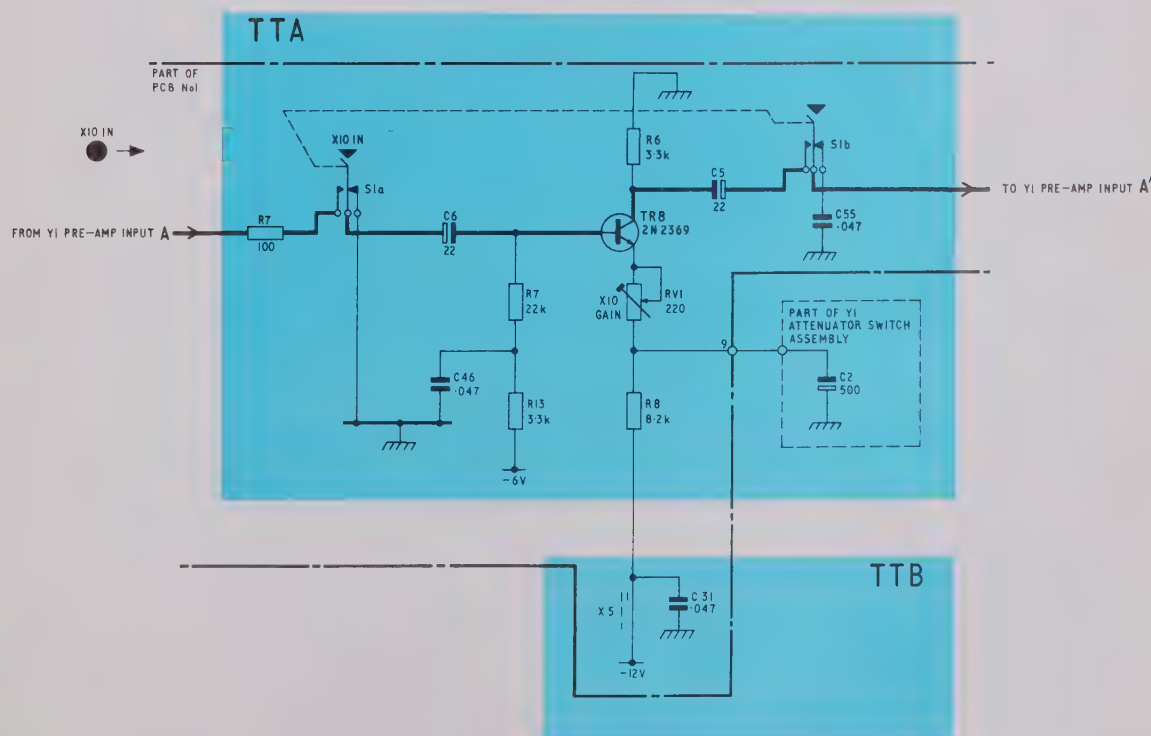
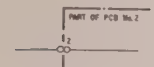


Fig. 9.9 Times Ten Amplifier (CA1017003)

Table 9.2 Test Information Points Y1 to Y5 - Pre-amplifiers

| Point    | DC Level | Voltage peak-to-peak               | Remarks                                                          |
|----------|----------|------------------------------------|------------------------------------------------------------------|
| Y1       | -2.09V   | 25mV                               | Reduce input signal to 30mV and select X10 for this measurement. |
| Y2       | 0V       | 30mV                               |                                                                  |
| Y3       | +1.38V   | 30mV                               |                                                                  |
| Y4       | -0.47V   | 25mV                               |                                                                  |
| Y5 (TP2) | -0.52V   | Not significant<br>(current drive) |                                                                  |

# Circuit Notes



Disconnect pin no. 2 of pcb no. 2



Edge connector no. 5 of pcb no. 2



Test information point

Typical voltage measurements at the pins of IC1 and IC2 are shown below. All measurements were made with standard front panel settings (see page 9.2) using a high impedance (10M $\Omega$ ) digital voltmeter. Where two figures are given, the upper shows the reading when the channel containing that IC is selected, the lower when it is not selected. The suffix (S) denotes that the reading is dependent on the position of the shift control for the channel in use.

|                   |                |    |       |    |                |              |          |
|-------------------|----------------|----|-------|----|----------------|--------------|----------|
| 20 Shift          | +12V           | 1  | +11.8 | 1  | +12V           | Shift 20     | +10.4(S) |
| 19 N.U.           | Trig. Out      | 2  | -0.42 | 2  | Trig. Out      | N.U. 19      | 0        |
| 18 Shift          | Sig. Out       | 3  | -0.48 | 3  | Sig. Out       | Shift 18     | +10.4(S) |
| 17 Sig Lo         | N.U.           | 4  | -0.51 | 4  | N.U.           | Sig Lo 17    | +0.71    |
| 16 Sig Hi         | Sig Out        | 5  | -0.49 | 5  | Sig Hi         | 16           | +0.71    |
| 15 Sig Hi Emitter | Trig Out       | 6  | -0.38 | 6  | Trig Out       | Sig Hi 15    | -0.72    |
| 14 Sig Lo Emitter | Output Tail    | 7  | -0.59 | 7  | Output Tail    | Sig Lo 14    | -0.72    |
| 13 +5V            | Beam Switching | 8  | -4.84 | 8  | Beam Switching | +6V 13       | +4.7     |
| 12 N.U.           | 0V             | 9  | -2.84 | 9  | 0V             | N.U. 12      | +2.56    |
| 11 Var. Gain      | -12V           | 10 | -6.63 | 10 | -12V           | Var. Gain 11 | -1.14    |
|                   |                |    | -1.30 |    |                |              |          |

Copper Side

Component Side

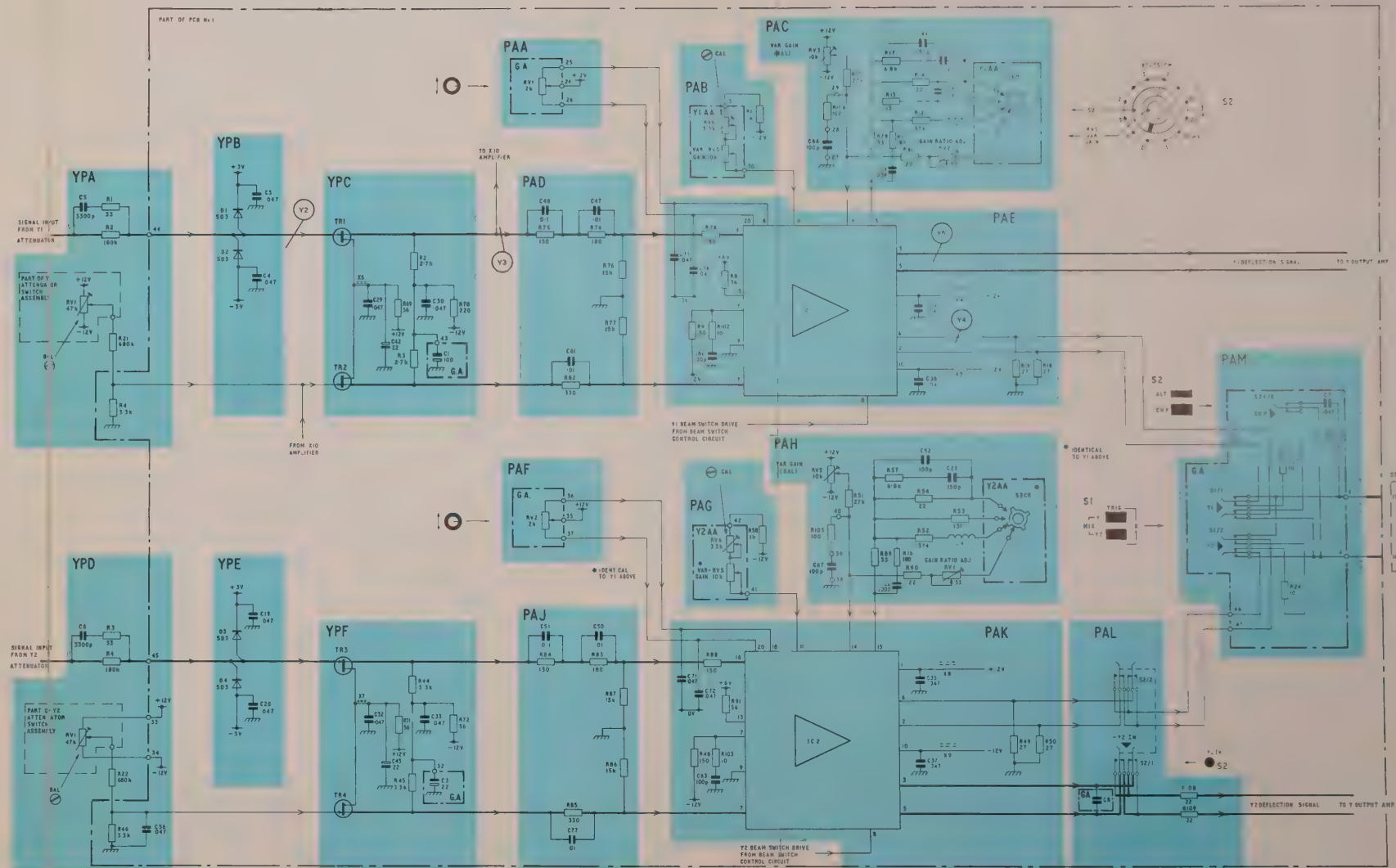
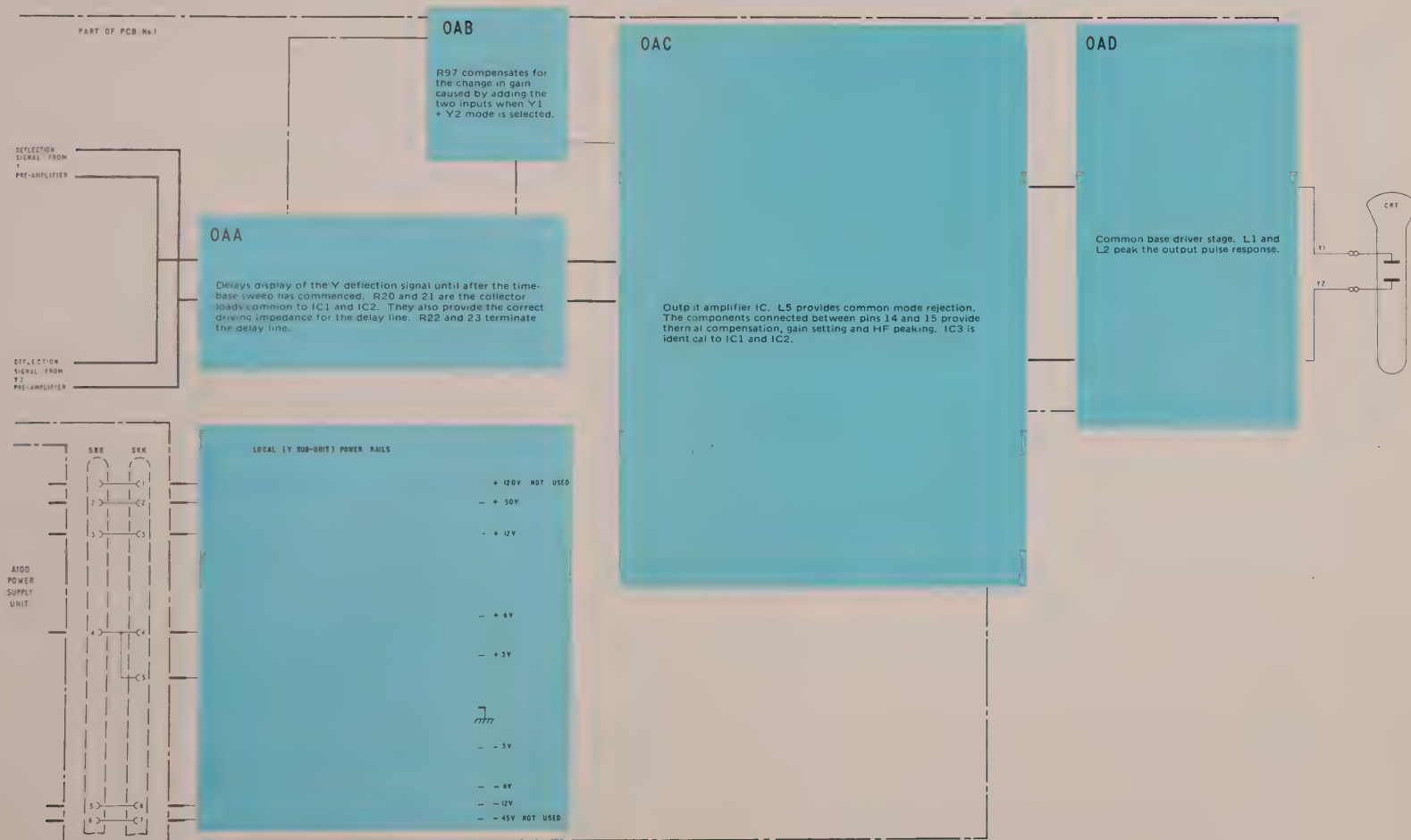


Fig. 9.10 Pre-amplifiers (DA1017002)



#### Procedure 101 Cal 2

Output amplifier centering.

1. Obtain a single line trace.
2. Connect a shorting link between TP1 and TP2.
3. Adjust RV6 on pcb No. 1 to centralise the trace vertically.
4. Remove shorting link.

#### Procedure 101 Cal 7

HF pulse response.

1. Apply a 1MHz fast-rise signal from the Tektronix 106 to the Y1 input via a 50Ω co-axial cable, terminated by a 50Ω in-line termination. Select Y1 mode and Y1 trigger.
2. Set TIME/CM to 0.5μs and Y1 sensitivity to 20mV/cm. Adjust generator output for a 6cm picture.
3. Adjust C53 for an approximately square leading edge.
4. Adjust C14 for a flat top to the trace.
5. Set TIME/CM to 0.1μs. Adjust C13 for a flat top to the first 100ns (1cm) following the leading edge.
6. Re-adjust C53 for optimum leading edge. Aberrations should not now exceed 1.7mm p-p.
7. Transfer the generator to Y2. Select Y2 mode. The trace should be similar to Y1 trace in para. 6, with aberrations not exceeding 2mm.
8. Disconnect the square-wave generator, and connect the Tektronix 191 constant-amplitude generator, using the same co-axial cable and termination. Set the generator output for a trace of 8cm amplitude at 50kHz.
9. Increase the generator frequency until the trace amplitude reduces to 5.6cm. This frequency should be at least 35MHz under normal ambient conditions, which will ensure that the specified 30MHz bandwidth is obtained under extreme conditions.
10. Repeat paras. 8 and 9 for sensitivities of 5, 10, 50, 100, 200 and 500mV/cm.

#### Note Adjustment of output amplifier gain (RV7)

This is an integral part of the overall gain setting procedure. See procedure 101 Cal 4 on pages 9.6 and 9.7.

Fig. 9.11 Output Amplifier and Local Supplies Block Diagram

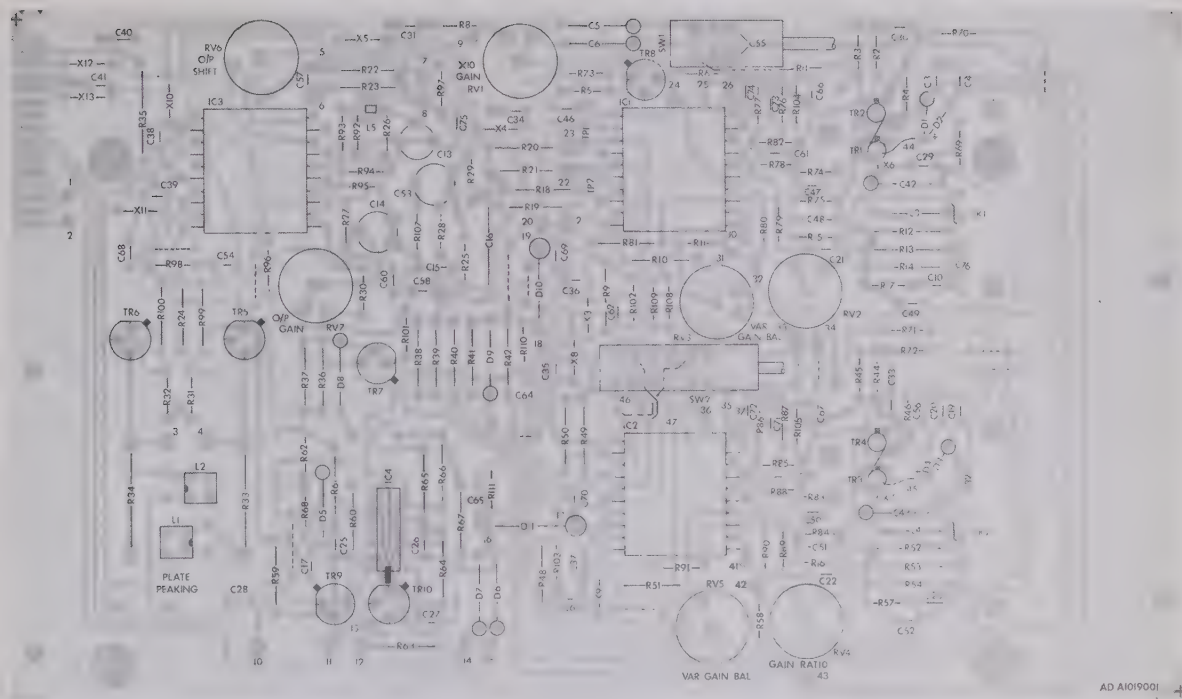


Fig. 9.12 PCB no. 1 (Component Side)

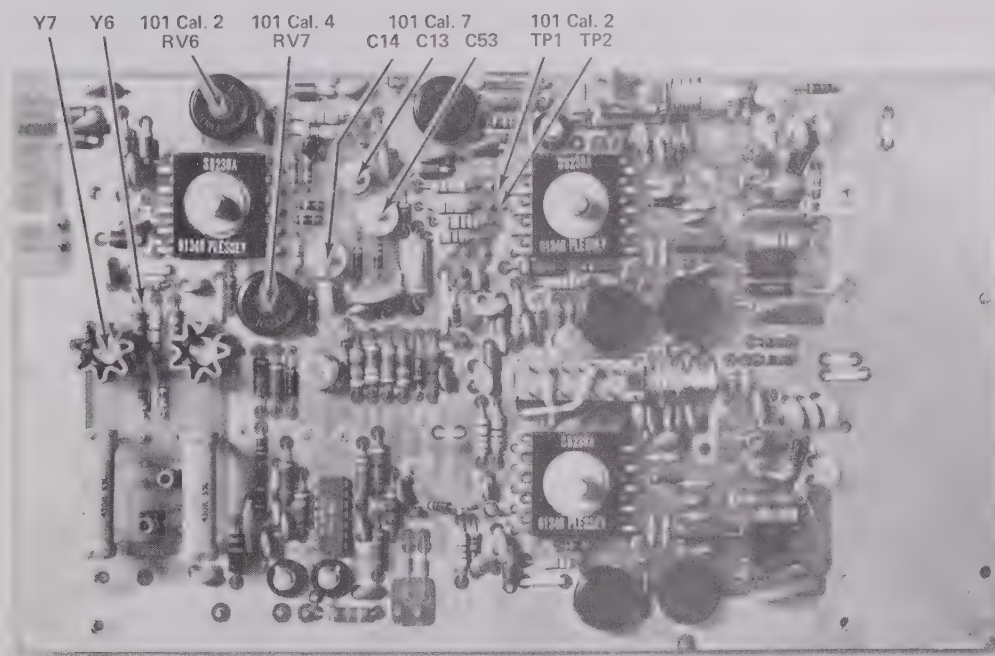


Fig. 9.13 PCB no. 1 (Attenuators, Switches and Heatsinks Removed)

Table 9.3 Test Information Points Y5 to Y7 - Output Amplifier

| Point | DC Level | Voltage peak-to-peak               | Remarks                                                                           |
|-------|----------|------------------------------------|-----------------------------------------------------------------------------------|
| Y5    | -0.52V   | Not significant<br>(current drive) |                                                                                   |
| Y6    | -0.68V   | Not significant<br>(current drive) |                                                                                   |
| Y7    | +19V     | 13V(nom.)                          | Amplitude depends on CRT Y-plate sensitivity,<br>and may vary between 12 and 14V. |

# Circuit Notes



Disconnect pin no. 2 of pcb no. 2

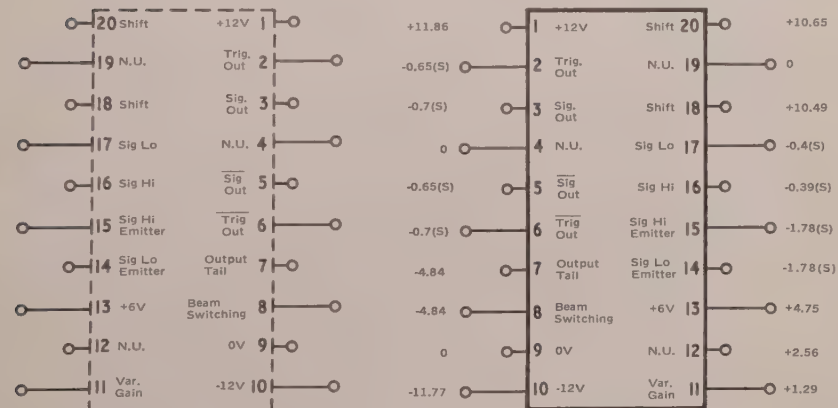


Edge connector no. 5 of pcb no. 2



Test information point

Typical voltage measurements at the pins of IC3 are shown below. All measurements were made with standard front panel settings (see page 9.2) using a high impedance (10M $\Omega$ ) digital voltmeter. Where a reading is suffixed (S), this denotes that the reading is dependent on the position of the shift control for the channel in use.



Copper Side

Component Side

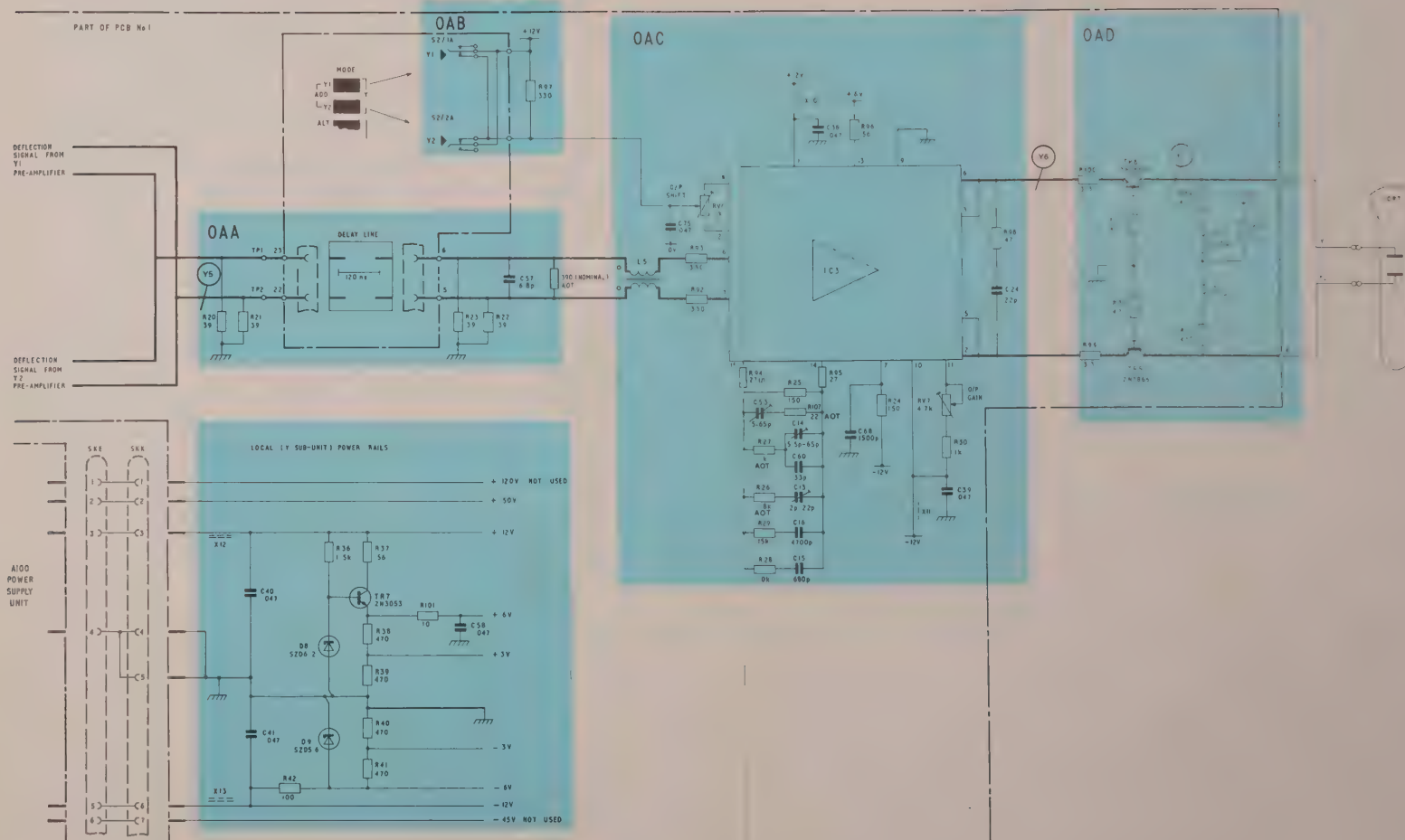


Fig. 9.14 Output Amplifier and Local Supplies (DA1007005)

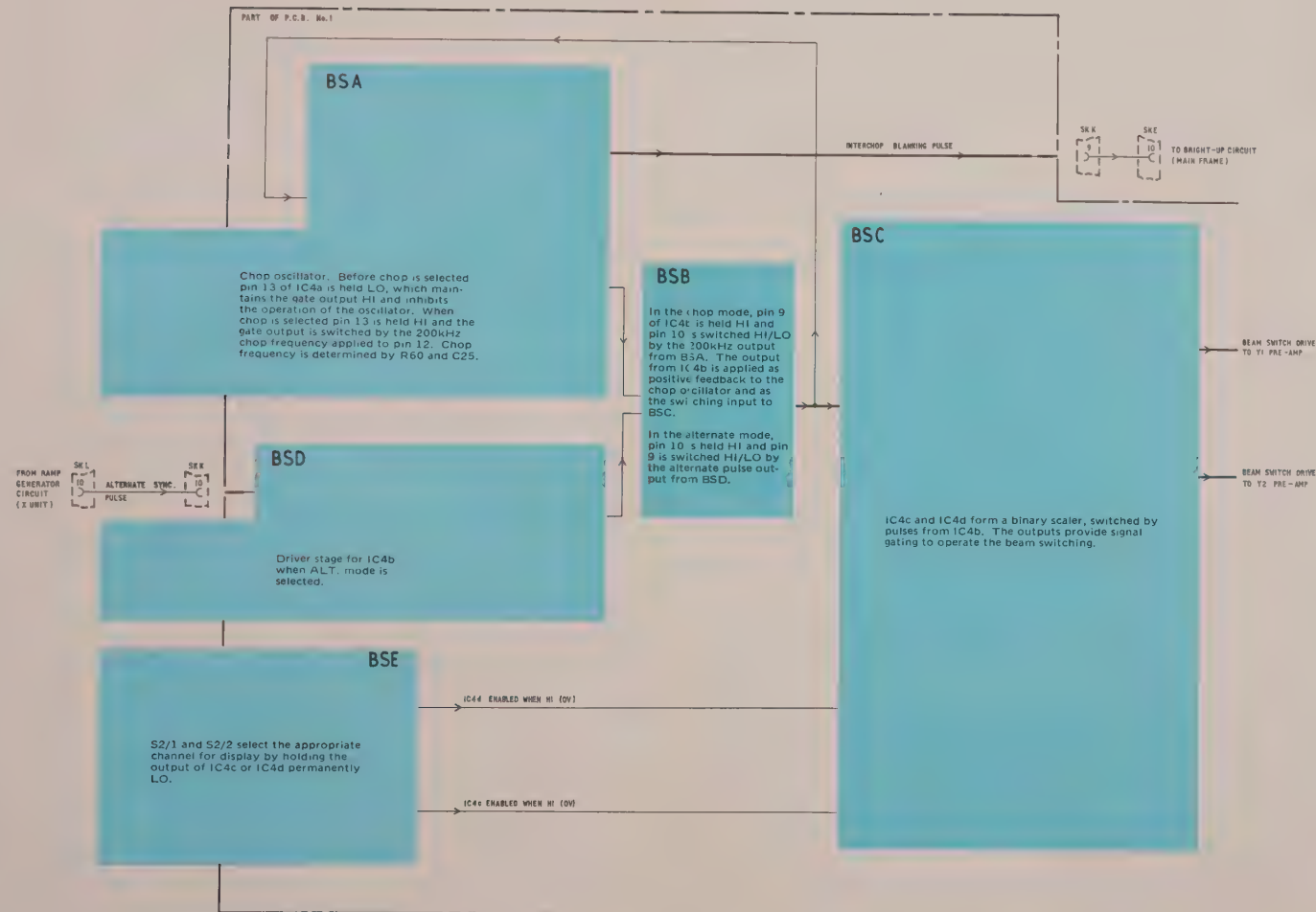


Fig. 9.15 Beamswitch Block Diagram

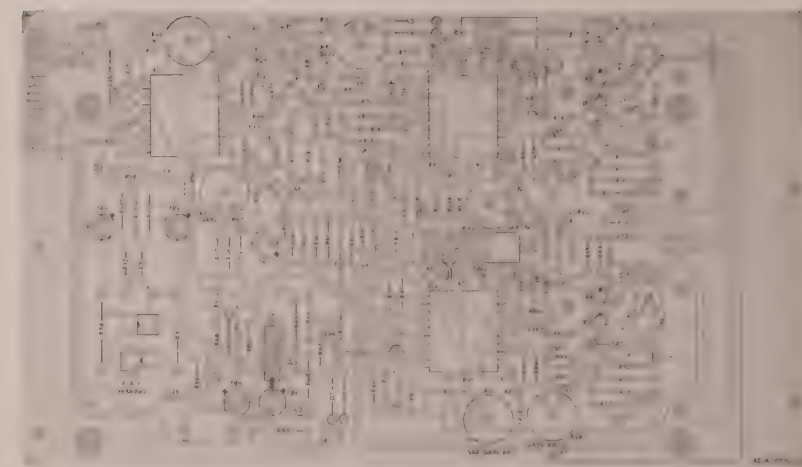


Fig. 9.16 PCB No.1 (Component Side)

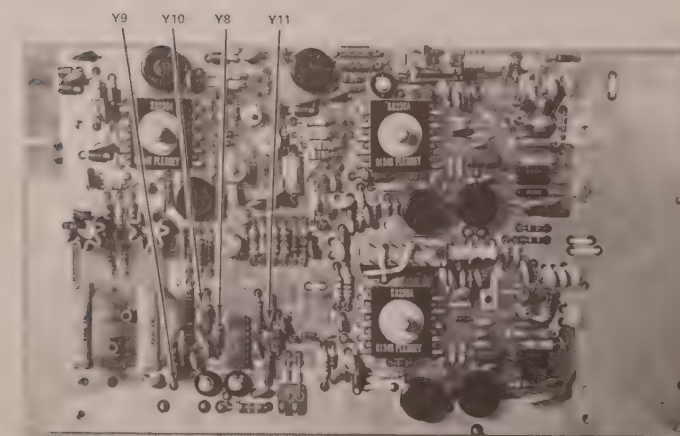
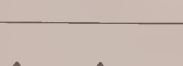
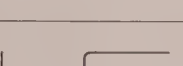


Fig. 9.17 PCB No.1 (Attenuators, Switches and Heatsinks Removed)

Table 9.4 Test Information points Y8 to Y11 - Beam Switch.

| Point | Measurement at Standard Settings                                                                                                                                               | Remarks                                   |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| Y8    |  - 2V                                                                                         |                                           |
|       |  - 6V                                                                                         |                                           |
| Y9    |  - 4.8V                                                                                       | Select 'chop' to display these waveforms. |
|       |  - 9V                                                                                         |                                           |
| Y10   |  0V<br> - 5V |                                           |
| Y11   |  0V<br> - 5V | Beam switching drive to IC1.              |

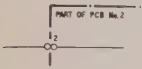
**Detailed description of the chop oscillator**

The chop oscillator consists of TR9, IC4a and their associated passive components, and IC4b. IC4b also passes the alternate sync pulse when operating in the ALT mode.

Examination of the DC conditions prevailing in this circuit will show that there is no stable state.

1. Assume the output (IC4b pin 8) is HI, at about -1V. This results in TR9 conducting, therefore its collector is at -5V, which is the logical LO in this circuit. This takes IC4a output HI, so IC4b output should be LO.
2. Assume the output is LO, the same reasoning applies, so that the output should be HI.
3. These anomalies can be solved if TR9 has some means of 'holding on' to a HI or LO as required. This is provided, for a short length of time, by the CR circuit C25 and R60, which either draw current from TR9 base or supply it. D5 is an isolating diode, which enables the output of IC4a to rise sharply while the junction of C25, R61 rises more slowly.

**Circuit Notes**



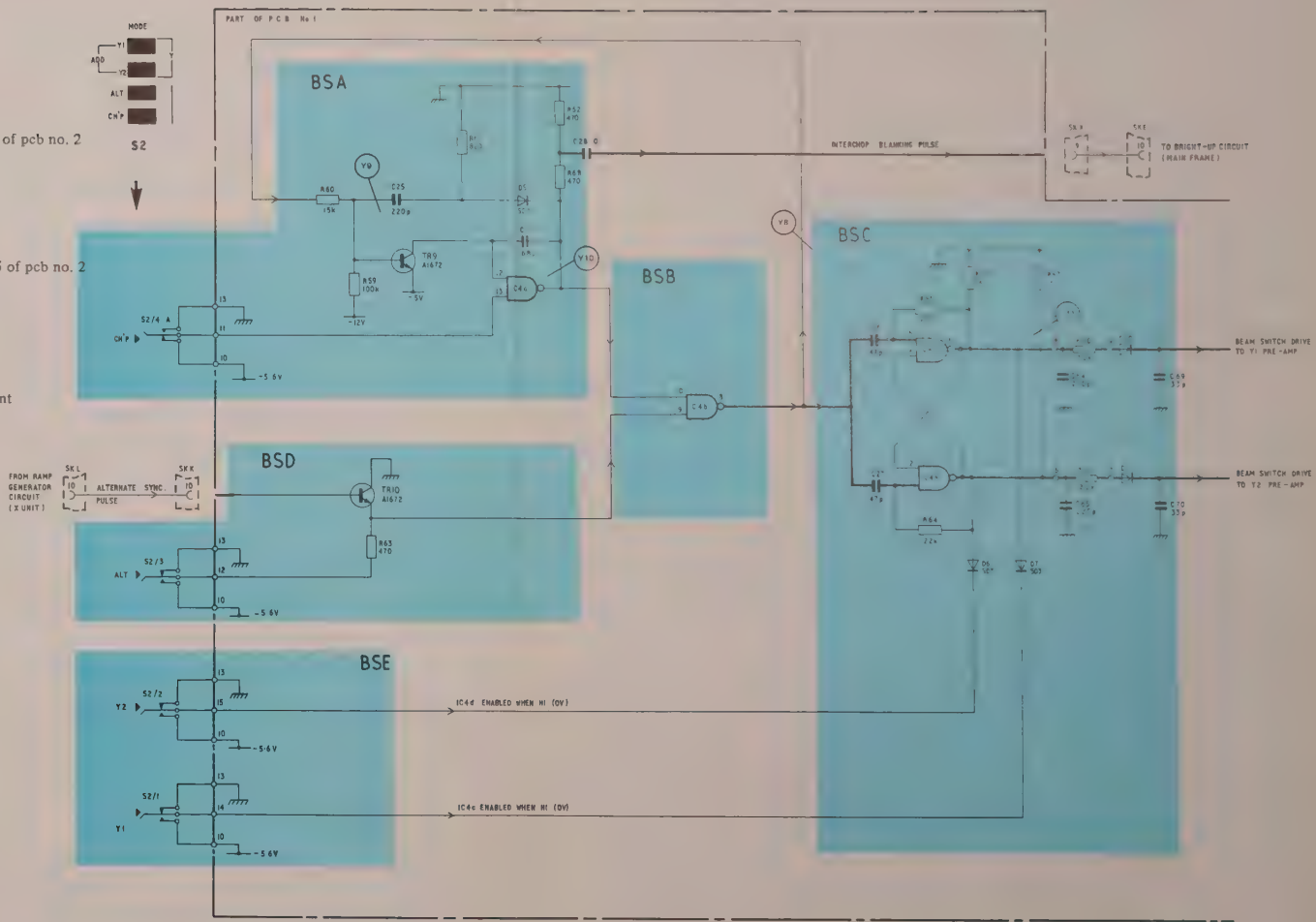
Disconnect pin no. 2 of pcb no. 2



Edge connector no. 5 of pcb no. 2



Test information point



COMPONENT PARTS LIST

ABBREVIATIONS

Circuit References

|     |                               |
|-----|-------------------------------|
| B   | Battery                       |
| C   | Capacitor ( $\mu F$ )         |
| CSR | Thyristor                     |
| D   | Diode                         |
| FS  | Fuse                          |
| IC  | Integrated Circuit            |
| L   | Inductor                      |
| LP  | Lamp (including Neon)         |
| LK  | Link                          |
| M   | Meter                         |
| MSP | Mains Selector Panel          |
| PL  | Plug                          |
| R   | Resistor ( $\Omega$ )         |
| RL  | Relay                         |
| S   | Switch                        |
| SK  | Socket                        |
| T   | Transformer                   |
| TP  | Terminal Post (or Test Point) |
| TR  | Transistor                    |
| V   | Valve                         |
| X   | Other Components              |

Also Used:-

|     |                                  |
|-----|----------------------------------|
| RNL | Non Linear Resistor ( $\Omega$ ) |
| RV  | Variable Resistor ( $\Omega$ )   |

Component Composition

FIXED RESISTORS

|                       |      |
|-----------------------|------|
| Carbon Composition    | CACP |
| Carbon Film           | CAFM |
| Cracked Carbon        | CKCA |
| Metal Film            | MEFM |
| Metal Oxide           | MEOX |
| Power Wirewound       | POWW |
| Precision Wirewound   | PRWW |
| Temperature Sensitive | TEMP |
| Thick Film            | TKFM |
| Thin Film             | TNFM |
| Voltage Sensitive     | VOLT |

Component Composition (Cont'd)

VARIABLE RESISTORS

|                                   |      |
|-----------------------------------|------|
| Wirewound Preset Single Turn      | WWPS |
| Wirewound Preset Multiturn        | WWPM |
| Wirewound Front Panel Single Turn | WWFS |
| Wirewound Front Panel Multiturn   | WWFM |
| Carbon Preset Single Turn         | CAPS |
| Carbon Preset Multiturn           | CAPM |
| Carbon Front Panel Single Turn    | CAFS |
| Carbon Front Panel Multiturn      | CAFM |
| Cermet Preset Single Turn         | CMPs |
| Cermet Preset Multiturn           | CMPM |
| Cermet Front Panel Single Turn    | CMFS |
| Cermet Front Panel Multiturn      | CMFM |

CAPACITORS

|                        |      |
|------------------------|------|
| Air                    | AIR  |
| Aluminium Electrolytic | ALME |
| Aluminium Solid        | ALMS |
| Polycarbonate          | CARB |
| Ceramic                | CERM |
| Polyester Foil         | ESTF |
| Polyester Metallised   | ESTM |
| Glass                  | GLAS |
| Mica                   | MICA |
| Metallised Lacquer     | MLAC |
| Paper Foil             | PAPF |
| Paper Metallised       | PAPM |
| PTFE                   | PTFE |
| Polypropylene Film     | PYLN |
| Polystyrene            | STYR |
| Tantalum Dry           | TAND |
| Tantalum Foil          | TANF |
| Tantalum Wet           | TANW |

Column 4 indicates rating (Watts or Volts)  
Column 5 indicates tolerance (%)

Component Parts List

for

General Assembly

| Cct.<br>Ref. | General Description |      |       |             |  | Solartron<br>Part No. |
|--------------|---------------------|------|-------|-------------|--|-----------------------|
| R1           | CACP                | 33   | .125  | 10          |  | 172013300             |
| R2           | CACP                | 180k | .25   | 10          |  | 172351800             |
| R3           | CACP                | 33   | 125   | 10          |  | 172013300             |
| R4           | CACP                | 180k | .25   | 10          |  | 172351800             |
| R5           | MEOX                | 680k | .5    | 1           |  | 195456800             |
| R6           | MEOX                | 680k | .5    | 1           |  | 195456800             |
| R7           | CACP                | 100  | .125  | 10          |  | 172021000             |
| R8           | CACP                | 10   | .125  | 10          |  | 172011000             |
| R9           | CACP                | .125 | 10    | 10          |  | 172011000             |
| R10          | CACP                | .125 | 10    | 10          |  | 172011000             |
| RV1          | WWPM                | 0.5  | 2k    | 20          |  | 110025120             |
| RV2          | WWPM                | 0.5  | 2k    | 20          |  | 110025120             |
| C1           | ALME                | 12V  | 100   | +100<br>-20 |  | 270481000             |
| C2           | ALME                | 12V  | 500   | +100<br>-20 |  | 270485000             |
| C3           | TAND                | 15V  | 22    | 20          |  | 208700015             |
| C5           | CERM                | 500V | 3300p | 20          |  | 241333300             |
| C6           | CERM                | 500V | 3300p | 20          |  | 241333300             |
| C7           | CERM                | 25V  | .047  | +50<br>-25  |  | 241944700             |
| C8           | CERM                | 500V | 15p   | 20          |  | 241311500             |

Component Parts List

for

Attenuator Assembly

| Cct.<br>Ref. | General Description |       |      |    |  | Solartron<br>Part No. |
|--------------|---------------------|-------|------|----|--|-----------------------|
| R1           | CACP                | 22    | .125 | 10 |  | 172012200             |
| R2           | CACP                | 12    | .125 | 10 |  | 172011200             |
| R3           | CACP                | 1M    | .125 | 10 |  | 172061000             |
| R4           | CACP                | 12    | .125 | 10 |  | 172011200             |
| R5           | MEFM                | 999k  | .5   | .5 |  | A17410012             |
| R6           | MEFM                | 1k    | .25  | .5 |  | A17410013             |
| R7           | MEFM                | 990k  | .5   | .5 |  | A17410021             |
| R8           | MEFM                | 10.1k | .25  | .5 |  | A17410022             |
| R9           | MEFM                | 900k  | .5   | .5 |  | A17410023             |
| R10          | MEFM                | 111k  | .25  | .5 |  | A17410024             |
| R11          | CACP                | 33    | .125 | 10 |  | 172013300             |
| R12          | CACP                | 33    | .125 | 10 |  | 172013300             |
| R13          | CACP                | 47    | .125 | 10 |  | 172014700             |
| R14          | CACP                | 56    | .125 | 10 |  | 172015600             |
| R15          | CACP                | 100   | .125 | 10 |  | 172021000             |
| R16          | CACP                | 33    | .125 | 10 |  | 172013300             |
| R17          | CACP                | 33    | .125 | 10 |  | 172013300             |
| R18          | MEFM                | 1M    | .5   | .5 |  | A17410029             |
| RV1          | Res. Var.           | 47k   | .25  | 20 |  | 119600301             |
| RV5          | Res. Var.           | 10k   | .25  | 20 |  | 119600201             |
| RV6          | Res. Var.           | 3.3k  | .25  | 20 |  | 119600401             |



| Cct.<br>Ref.     | General Description |       |     |     |  | Solartron<br>Part No. | Cct<br>Ref.     | General Description |  |  |  |  | Solartron<br>Part No. |
|------------------|---------------------|-------|-----|-----|--|-----------------------|-----------------|---------------------|--|--|--|--|-----------------------|
| C3               | CERM                | .047  | 25  | +50 |  | 241944700             | D1              | IN3595              |  |  |  |  | 300523590             |
| C4               | CERM                | .047  | 25  | -25 |  | 241944700             | D2              | IN3595              |  |  |  |  | 300523590             |
|                  |                     |       |     | +50 |  |                       | D3              | IN3595              |  |  |  |  | 300523590             |
|                  |                     |       |     | -25 |  |                       | D4              | IN3595              |  |  |  |  | 300523590             |
| C5               | TAND                | 22    | 15  | 20  |  | 208700015             | D5              | Diode SD3           |  |  |  |  | 300522160             |
| C6               | TAND                | 22    | 15  | 20  |  | 208700015             | D6              | Diode SD3           |  |  |  |  | 300522160             |
| C10              | CERM                | 150p  | 500 | 20  |  | 241321500             | D7              | Diode SD3           |  |  |  |  | 300522160             |
| C13              | Trimmer             | 22p   | 50  |     |  | 290030180             | D8              | Silicon Zener 6.2V  |  |  |  |  | 300521240             |
| C14              | Trimmer             | 65p   | 50  |     |  | 290030190             | D9              | Silicon Zener 5.6V  |  |  |  |  | 300521450             |
| C15              | CERM                | 680p  | 500 | 10  |  | 208450116             | D10             | Diode SD3           |  |  |  |  | 300522160             |
| C16              | ESTF                | 4700p | 500 | 10  |  | 221334700             | D11             | Diode SD3           |  |  |  |  | 300522160             |
| C17              | CERM                | 68p   | 500 | 20  |  | 241316800             | TR1/<br>TR2     | Matched F.E.T.'s    |  |  |  |  | 300400102             |
| C19              | CERM                | .047  | 25  | +50 |  | 241944700             | TR3/<br>TR4     | Matched F.E.T.'s    |  |  |  |  | 300400102             |
|                  |                     |       |     | -25 |  |                       |                 |                     |  |  |  |  |                       |
| C20              | CERM                | .047  | 25  | +50 |  | 241944700             |                 |                     |  |  |  |  |                       |
|                  |                     |       |     | -25 |  |                       |                 |                     |  |  |  |  |                       |
| C21              | CERM                | 100p  | 500 | 20  |  | 241321000             | TR5             | 2N3866              |  |  |  |  | A17400008             |
| C22              | CERM                | 100p  | 500 | 20  |  | 241321000             | TR6             | 2N3866              |  |  |  |  | A17400008             |
| C23              | CERM                | 150p  | 500 | 20  |  | 241321500             | TR7             | 2N3053              |  |  |  |  | 300551800             |
| C25              | CERM                | 220p  | 500 | 20  |  | 241322200             | TR8             | 2N2369              |  |  |  |  | 300552390             |
| C26              | CERM                | 47p   | 500 | 20  |  | 241314700             | TR9             | A1672               |  |  |  |  | 300551910             |
| C27              | CERM                | 47p   | 500 | 20  |  | 241314700             | TR10            | A1672               |  |  |  |  | 300551910             |
| C28              | CERM                | .01   | 25  | +50 |  | 241941000             | IC1             | Plessey SB230A      |  |  |  |  | 519600201             |
|                  |                     |       |     | -25 |  |                       | IC2             | Plessey SB230A      |  |  |  |  | 519600201             |
| C29<br>to<br>C41 | CERM                | .047  | 25  | +50 |  | 241944700             | IC3             | Plessey SB230A      |  |  |  |  | 519600201             |
|                  |                     |       |     | -25 |  |                       | IC4             | 846                 |  |  |  |  | 510000160             |
| C42              | TAND                | 22    | 15  | 20  |  | 208700015             | L1              | Inductor .75mH      |  |  |  |  | 309500201             |
| C43              | TAND                | 22    | 15  | 20  |  | 208700015             | L2              | Inductor .75mH      |  |  |  |  | 309500201             |
| C46              | CERM                | .047  | 25  | +50 |  | 241944700             | L3              | Inductor .16mH      |  |  |  |  | 305020500             |
|                  |                     |       |     | -25 |  |                       | L4              | Inductor .16mH      |  |  |  |  | 305020500             |
| C47              | CERM                | .01   | 25  | +50 |  | 241941000             | L5              | Common Mode Choke   |  |  |  |  | 309500602             |
|                  |                     |       |     | -25 |  |                       |                 |                     |  |  |  |  |                       |
| C48              | ESTM                | 0.1   | 100 | 10  |  | 225451000             | X3<br>to<br>X13 | Ferrite Bead        |  |  |  |  | 309010060             |
| C49              | CERM                | 150p  | 500 | 10  |  | 208450117             |                 |                     |  |  |  |  |                       |
| C50              | CERM                | .01   | 25  | +50 |  | 241941000             | SW1<br>SW2      | Switch Push Button  |  |  |  |  | 379601001             |
|                  |                     |       |     | -25 |  |                       |                 | Switch Push Button  |  |  |  |  | 379600801             |
| C51              | ESTM                | 0.1   | 100 | 10  |  | 225451000             |                 |                     |  |  |  |  |                       |
| C52              | CERM                | 100p  | 500 | 10  |  | 208450115             |                 |                     |  |  |  |  |                       |
| C53              | Trimmer             | 5/65p | 50  |     |  | 290030190             |                 |                     |  |  |  |  |                       |
| C54              | CERM                | 22p   | 500 | 20  |  | 241312200             |                 |                     |  |  |  |  |                       |
| C55              | CERM                | .047  | 25  | +50 |  | 241944700             |                 |                     |  |  |  |  |                       |
|                  |                     |       |     | -25 |  |                       |                 |                     |  |  |  |  |                       |
| C56              | CERM                | .047  | 25  | +50 |  | 241944700             |                 |                     |  |  |  |  |                       |
|                  |                     |       |     | -25 |  |                       |                 |                     |  |  |  |  |                       |
| C57              | CERM                | 6.8p  | 500 | 20  |  | 241306800             |                 |                     |  |  |  |  |                       |
| C58              | CERM                | .047  | 25  | +50 |  | 241944700             |                 |                     |  |  |  |  |                       |
|                  |                     |       |     | -25 |  |                       |                 |                     |  |  |  |  |                       |
| C60              | CERM                | 33p   | 500 | 20  |  | 241313300             |                 |                     |  |  |  |  |                       |
| C61              | CERM                | .01   | 25  | +50 |  | 241941000             |                 |                     |  |  |  |  |                       |
|                  |                     |       |     | -25 |  |                       |                 |                     |  |  |  |  |                       |
| C62              | CERM                | 100p  | 500 | 20  |  | 241321000             |                 |                     |  |  |  |  |                       |
| C63              | CERM                | 100p  | 500 | 20  |  | 241321000             |                 |                     |  |  |  |  |                       |
| C64              | CERM                | 220p  | 500 | 20  |  | 241322200             |                 |                     |  |  |  |  |                       |
| C65              | CERM                | 220p  | 500 | 20  |  | 241322200             |                 |                     |  |  |  |  |                       |
| C66              | CERM                | 100p  | 500 | 20  |  | 241321000             |                 |                     |  |  |  |  |                       |
| C67              | CERM                | 100p  | 500 | 20  |  | 241321000             |                 |                     |  |  |  |  |                       |
| C68              | CERM                | 1500p | 500 | 20  |  | 241331500             |                 |                     |  |  |  |  |                       |
| C69              | CERM                | 33p   | 500 | 20  |  | 241313300             |                 |                     |  |  |  |  |                       |
| C70              | CERM                | 33p   | 500 | 20  |  | 241313300             |                 |                     |  |  |  |  |                       |
| C71<br>to<br>C75 | CERM                | .047  | 25  | +50 |  | 241944700             |                 |                     |  |  |  |  |                       |
|                  |                     |       |     | -25 |  |                       |                 |                     |  |  |  |  |                       |
| C76              | CERM                | 500V  | 10p | 20  |  | 241311000             |                 |                     |  |  |  |  |                       |
| C77              | CERM                | 25V   | .01 | +50 |  | 241941000             |                 |                     |  |  |  |  |                       |

# SECTION 10      Single Timebase A111

---

## Outline Description      (refer to block diagram)

The A111 is a single timebase generator, capable of generating basic triggered or free-running sweeps from  $0.1\mu\text{s}/\text{cm}$  to  $0.5\text{sec}/\text{cm}$ . The sweep speed can be extended to  $20\text{ns}/\text{cm}$  by the X5 amplifier, and reduced to  $1.25\text{sec}/\text{cm}$  by the variable sweep speed control.

The trigger source is selected by one of three push-buttons, the signal from the Y module being amplified before selection. The selected signal is passed to a FET input buffer amplifier, which provides a  $1\text{M}\Omega$  impedance for external trigger and XY plot input signals. If XY is selected, this signal then passes to the output amplifier and thence to the X plates, the intermediate stages being inoperative.

If a timebase speed is selected, the trigger signal passes from the input buffer to the trigger generator. This produces a positive-going edge coincident with the positive or negative-going edge of the triggering signal, depending on the trigger polarity selection. In the absence of a trigger signal, if 'AUTO' is selected, the trigger generator produces a train of pulses to the timebase generator, thus allowing a baseline to be displayed.

The generated positive-going edge is applied to the ramp initiator circuitry, via a patented anti-jitter circuit. This eliminates the jitter which normally occurs when the end of hold-off and the trigger pulse are coincident.

The output of this circuit, via a Schmitt trigger, causes the ramp generator to commence its run-up. The end-of-ramp detector switches over when the ramp reaches a defined voltage level; the output of the end-of-ramp detector, being a rectangular waveform coincident with the ramp, is used to generate the bright-up waveform and the alternate trace sync pulse.

Outline Calibration Procedure

For a full calibration, adjustments should be made in the order given in table 10.1. All adjustable components are mounted on pcb No. 1

Table 10.1 A111 Calibration

| Procedure | Description                              | Test Equipment Required |
|-----------|------------------------------------------|-------------------------|
| 111 Cal 1 | Mean plate potential                     | 1                       |
| 111 Cal 2 | Horizontal gain and LF pulse response.   | 2                       |
| 111 Cal 3 | Ramp rate                                | 2                       |
| 111 Cal 4 | HF pulse response and Sweep speed check. | 2                       |

Test Equipment Requirements

| Item | Description             | Minimum Specification | Suggested Instrument |
|------|-------------------------|-----------------------|----------------------|
| 1    | Multimeter              | 10kΩ/V                | AVO model 8          |
| 2    | Oscilloscope calibrator |                       | Bradley 192 or 156   |

Standard Settings

The waveforms and voltages at the measuring points in this module were taken from a service-able instrument with the controls set as follows:-

|               |          |
|---------------|----------|
| TIME/CM       | 0.5ms    |
| Variable      | CAL      |
| X5            | OUT      |
| TRIG coupling | AC       |
| Trig polarity | +        |
| Trig source   | INT      |
| LEVEL         | Central  |
| Display       | 1kHz 6cm |

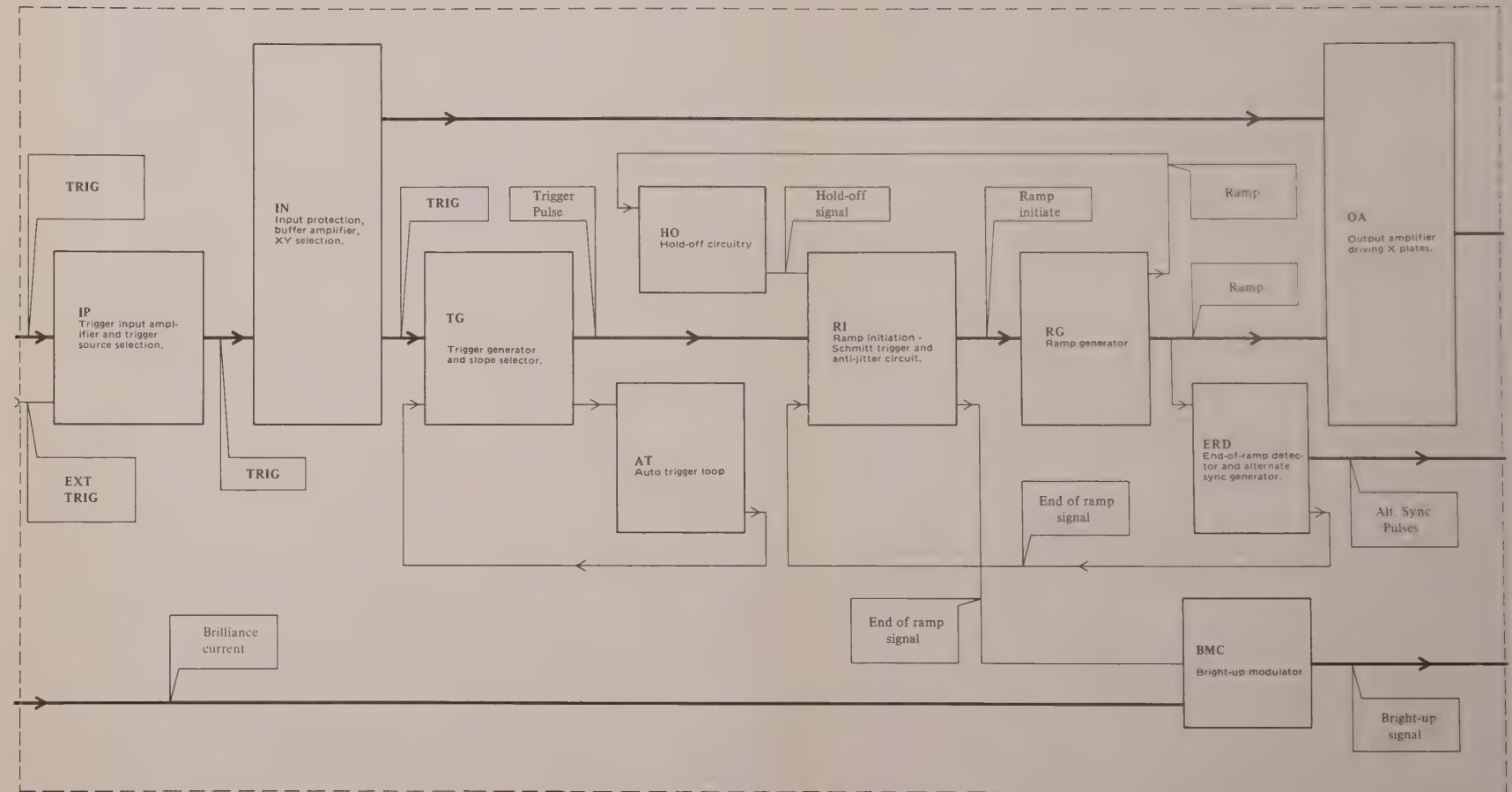


Fig. 10.1 A111 Block Diagram

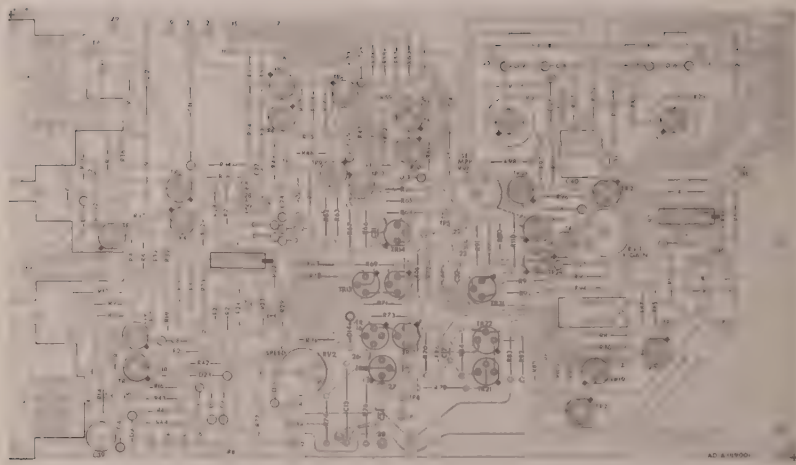
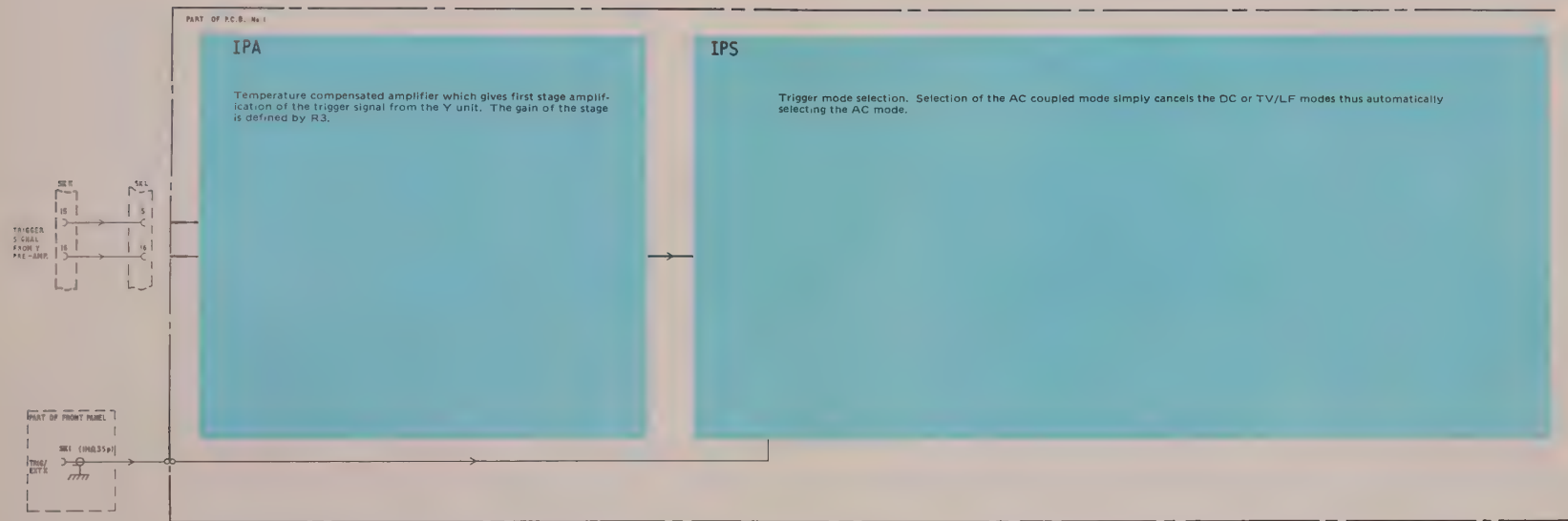


Fig. 10.3 PCB no.1 (Component Side).

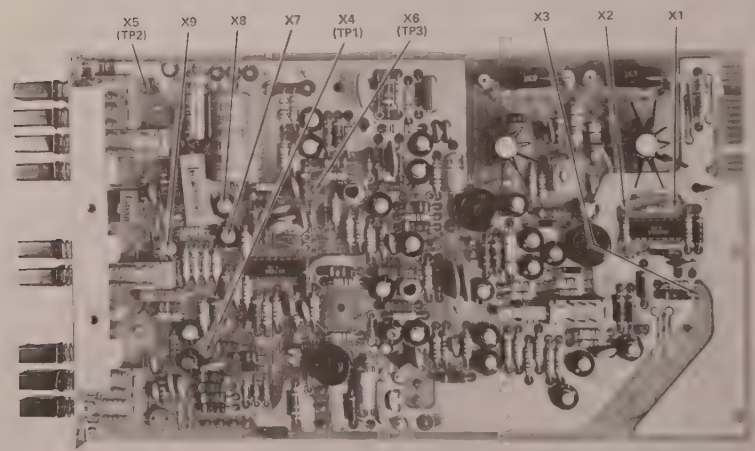


Fig. 10.4 PCB no.1 (Front Panel Assembly Removed)

Fig. 10.2 Input Amplifier and Switching Block Diagram

Circuit Notes

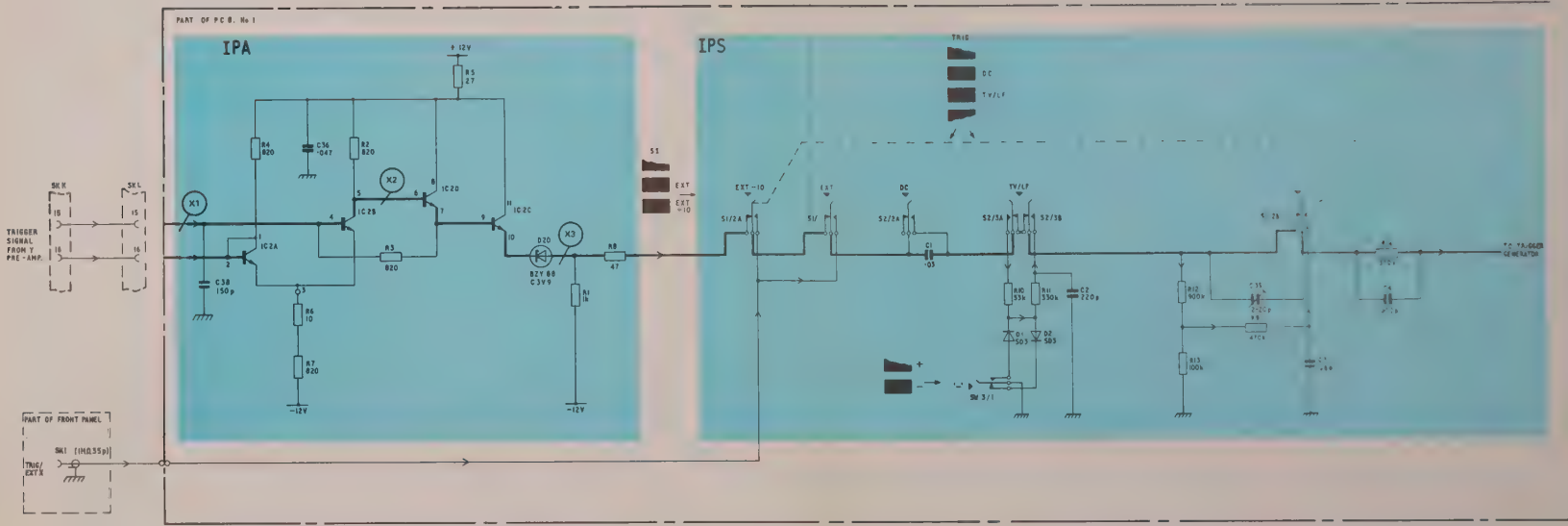
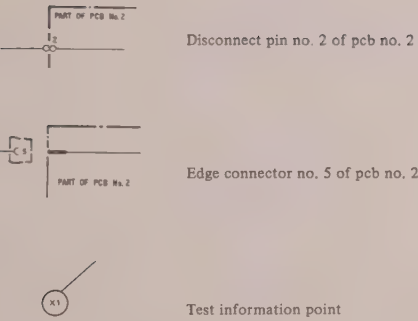


Table 10.2 Test Information Points X1 to X3 - Input Amplifier

| Point | DC Level | Voltage Peak-to-Peak | Remarks                                          |
|-------|----------|----------------------|--------------------------------------------------|
| X1    | -0.47V   | 25mV                 | A DC level of between +0.7V and -0.7V is normal. |
| X2    | +4.9V    | 3.1V                 |                                                  |
| X3    | -0.5V    | 3V                   | A DC level of between +0.7V and -0.7V is normal. |

Fig. 10.5 Input Amplifier and Switching (DA1117001)

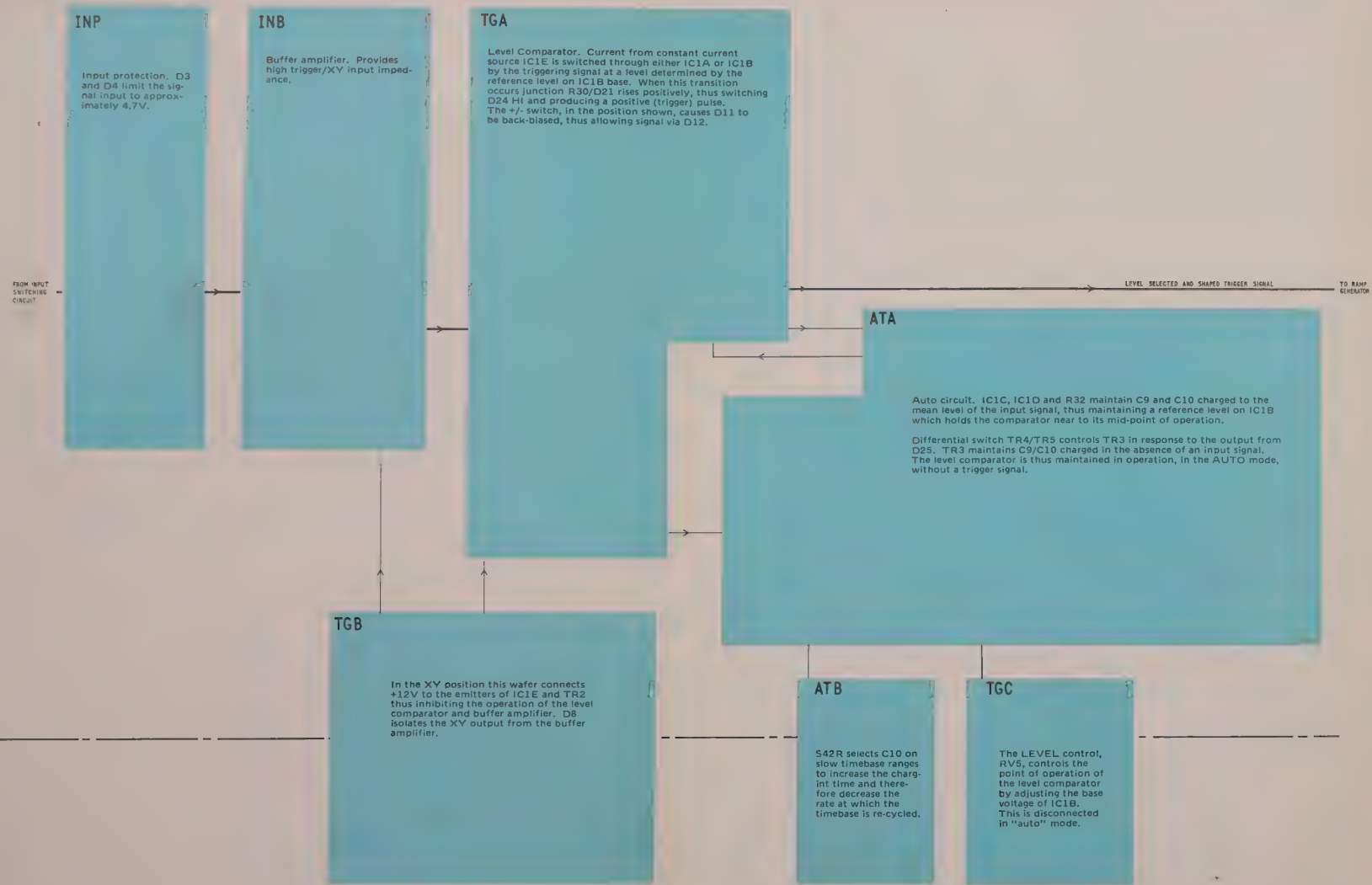


Fig. 10.6 Trigger Generator Block Diagram



Fig. 10.7 PCB no.1 (Component Side)

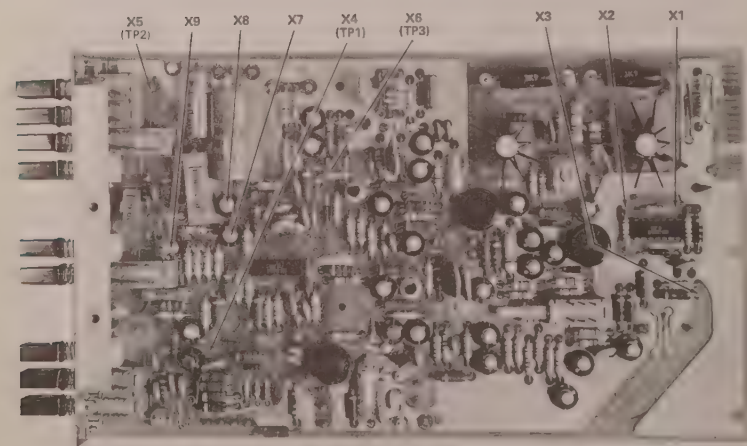


Fig. 10.8 PCB no.1 (Front Panel Assembly Removed)

Circuit Notes

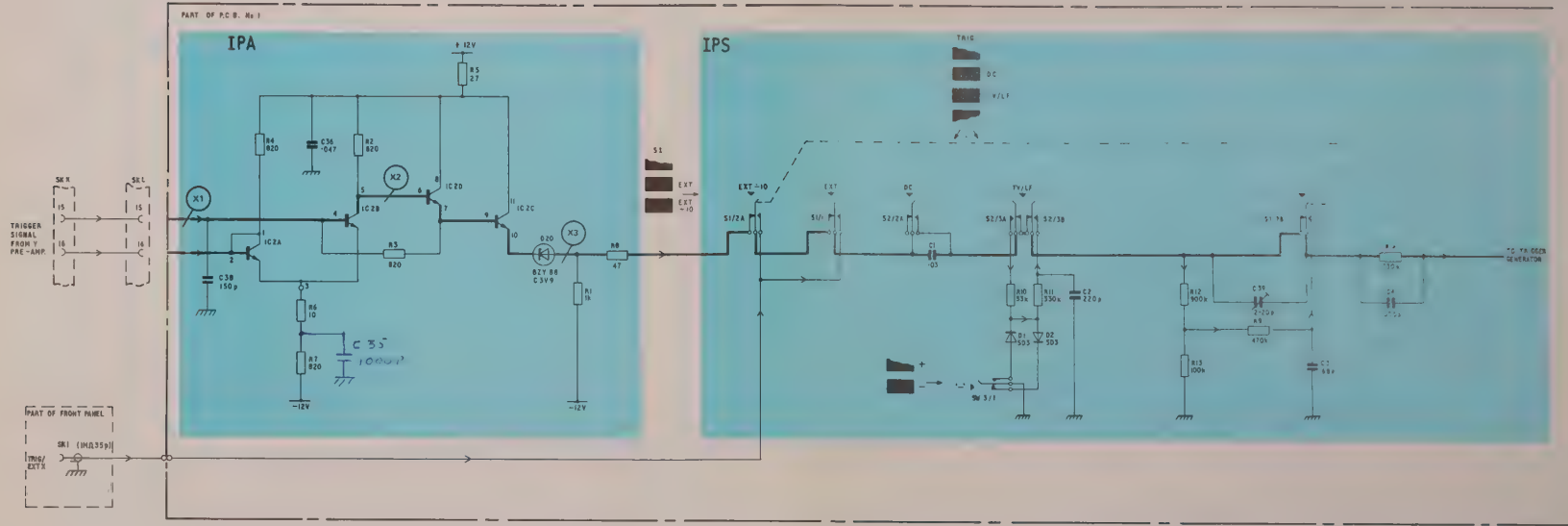
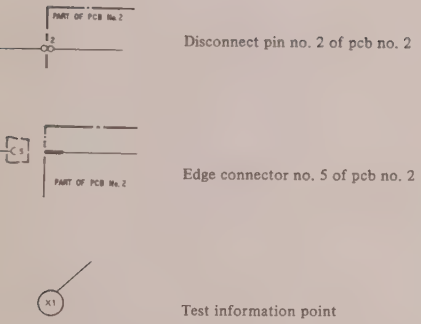


Table 10.2 Test Information Points X1 to X3 - Input Amplifier

| Point | DC Level | Voltage Peak-to-Peak | Remarks                                          |
|-------|----------|----------------------|--------------------------------------------------|
| X1    | -0.47V   | 25mV                 | A DC level of between +0.7V and -0.7V is normal. |
| X2    | +4.9V    | 3.1V                 |                                                  |
| X3    | -0.5V    | 3V                   | A DC level of between +0.7V and -0.7V is normal. |

Fig. 10.5 Input Amplifier and Switching (DA1117001)

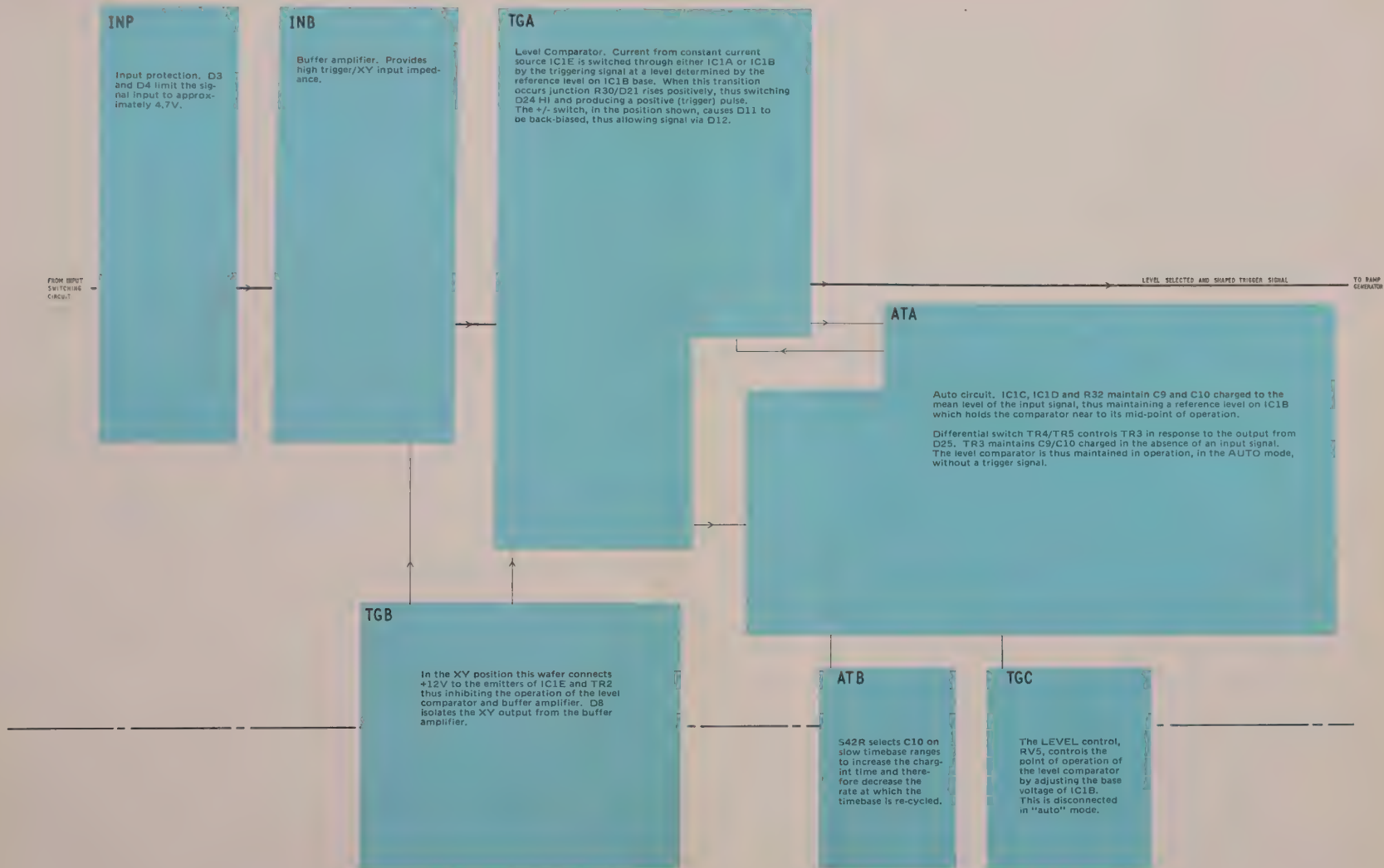


Fig. 10.6 Trigger Generator Block Diagram

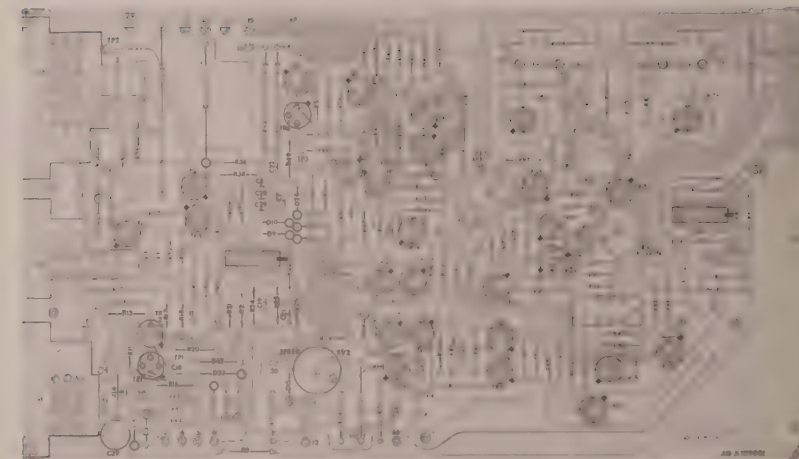


Fig. 10.7 PCB no.1 (Component Side)

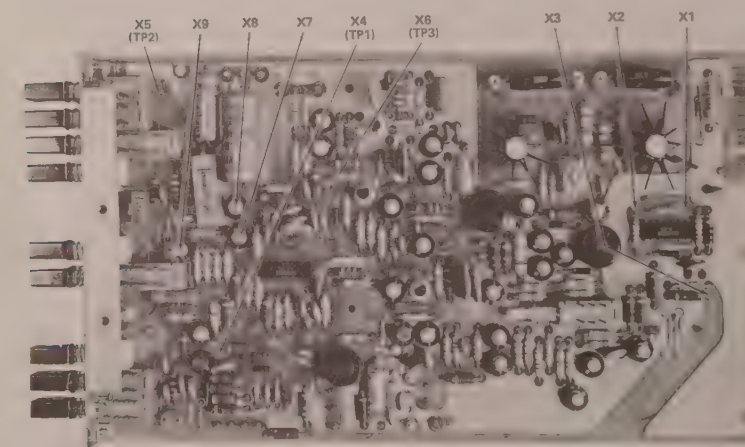
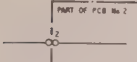


Fig. 10.8 PCB no.1 (Front Panel Assembly Removed)

Circuit Notes



Disconnect pin no. 2 of pcb no. 2



Edge connector no. 5 of pcb no. 2



Test information point

Table 10.3 Test Information Points X4 to X9 - Trigger Generator

| Point    | Measurement at Standard Settings | Remarks                                                  |
|----------|----------------------------------|----------------------------------------------------------|
| X4 (TP1) | +2.5V<br>-0.4V                   |                                                          |
| X5 (TP2) | +25mV<br>+21mV                   | When 'auto' is selected, waveform changes to that of X9. |
| X6 (TP3) | +0.5V<br>0V                      |                                                          |
| X7       | +12.5V<br>+2.5V                  |                                                          |
| X8       | +4.5<br>+2.2                     |                                                          |
| X9       | +0.62<br>+0.58                   |                                                          |

PART OF PCB No. 1

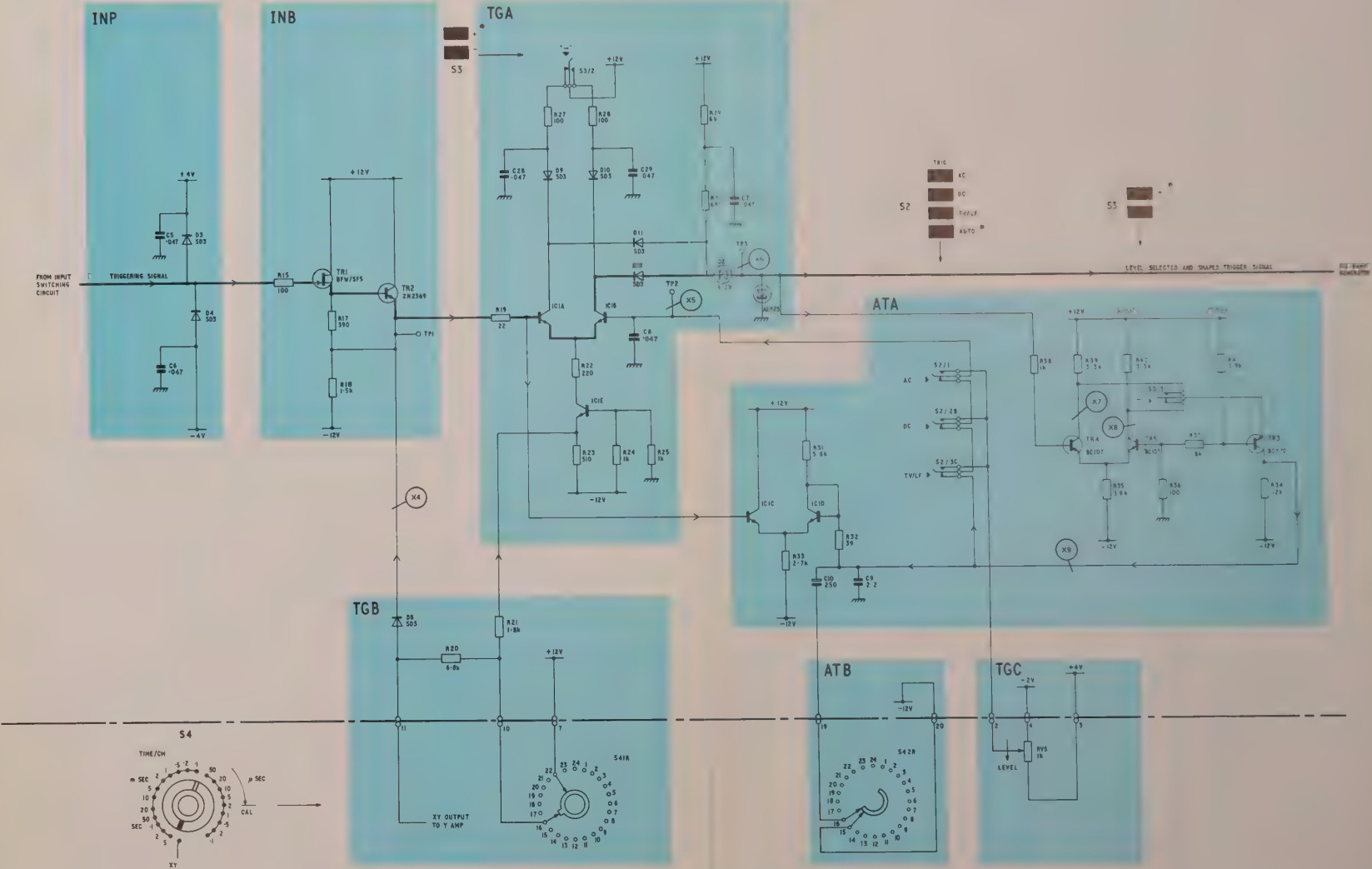


Fig. 10.9 Trigger Generator (DA1117002)

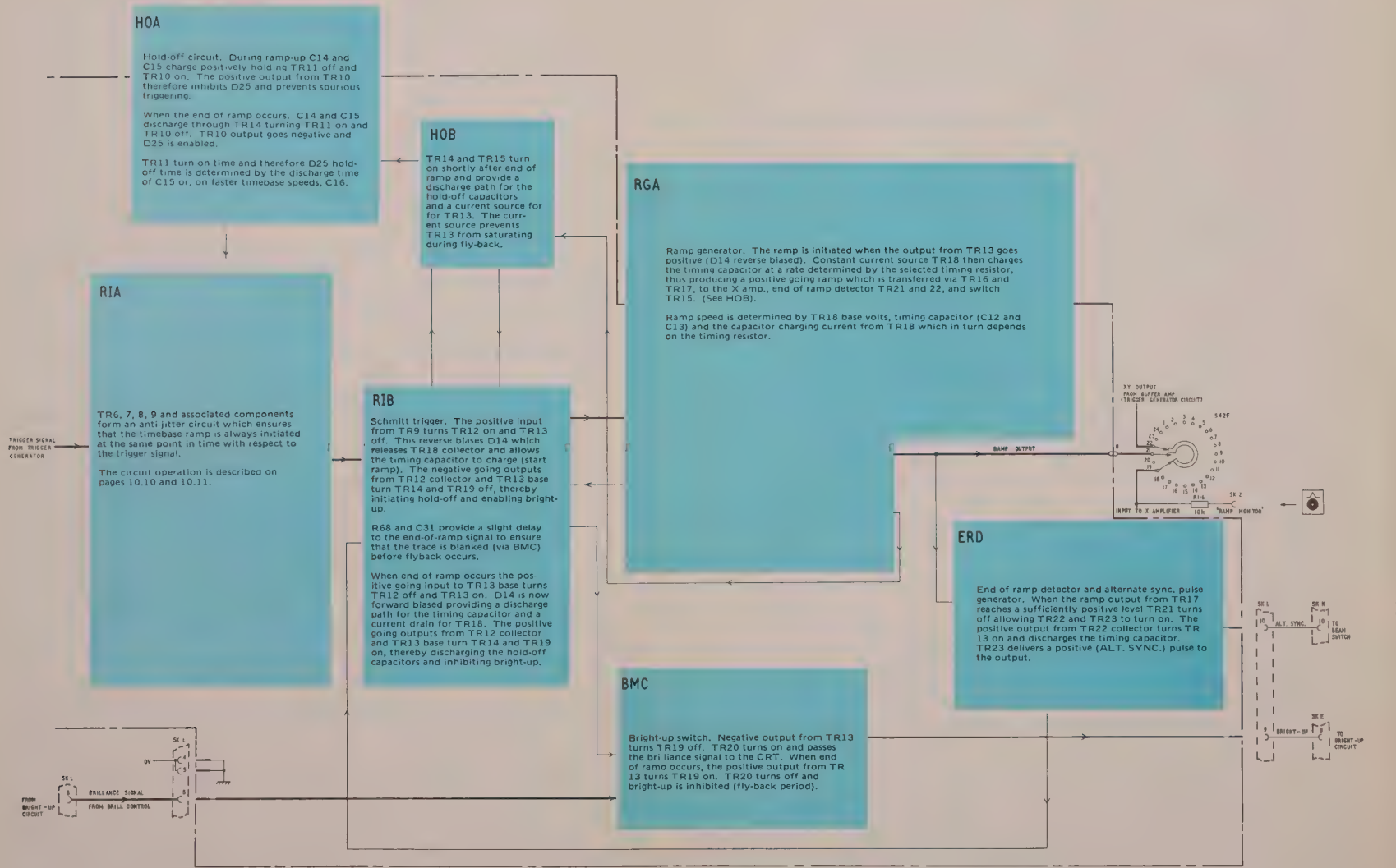


Fig. 10.10 Ramp Generator Block Diagram

- Procedure 111 Cal 3
- Ramp rate.
1. Set TIME/CM switch to 1ms, and fine velocity to CAL.
  2. Display 1kHz time markers from Bradley 192 or 156.
  3. Adjust RV2 to obtain maximum accuracy over the centre 8cm.

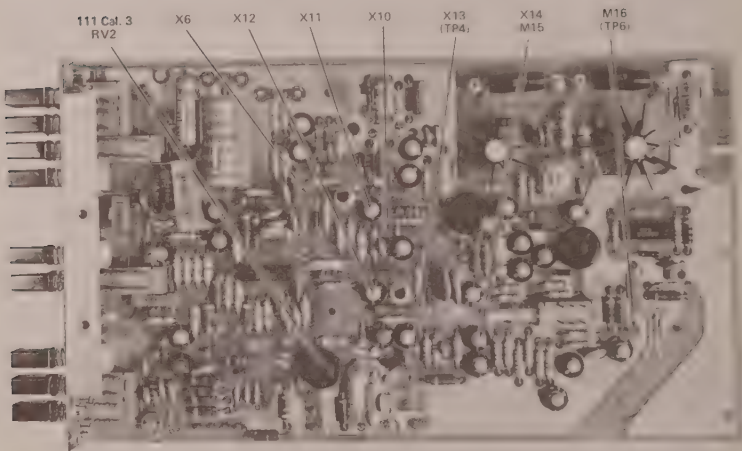
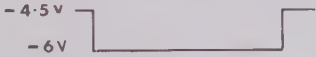
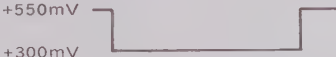


Fig. 10.11 PCB no. 1 (Front Panel Assembly Removed)

Table 10.4 Test Information Points X10 to X14 - Ramp Generator

| Point | Measurement at Standard Settings | Remarks |
|-------|----------------------------------|---------|
| X6    | + 0.5V<br>0V                     |         |
| X10   | - 3.7V<br>- 5V                   |         |
| X11   | - 1V<br>- 3.5V<br>- 4V           |         |
| X12   | + 4<br>- 1<br>- 2.4              |         |

Table 10.4 (Continued)

| Point     | Measurement at Standard Settings                                                  | Remarks       |
|-----------|-----------------------------------------------------------------------------------|---------------|
| X13 (TP4) |  |               |
| X14 (M15) |  | See Fig. 8.15 |
| M16       |  |               |

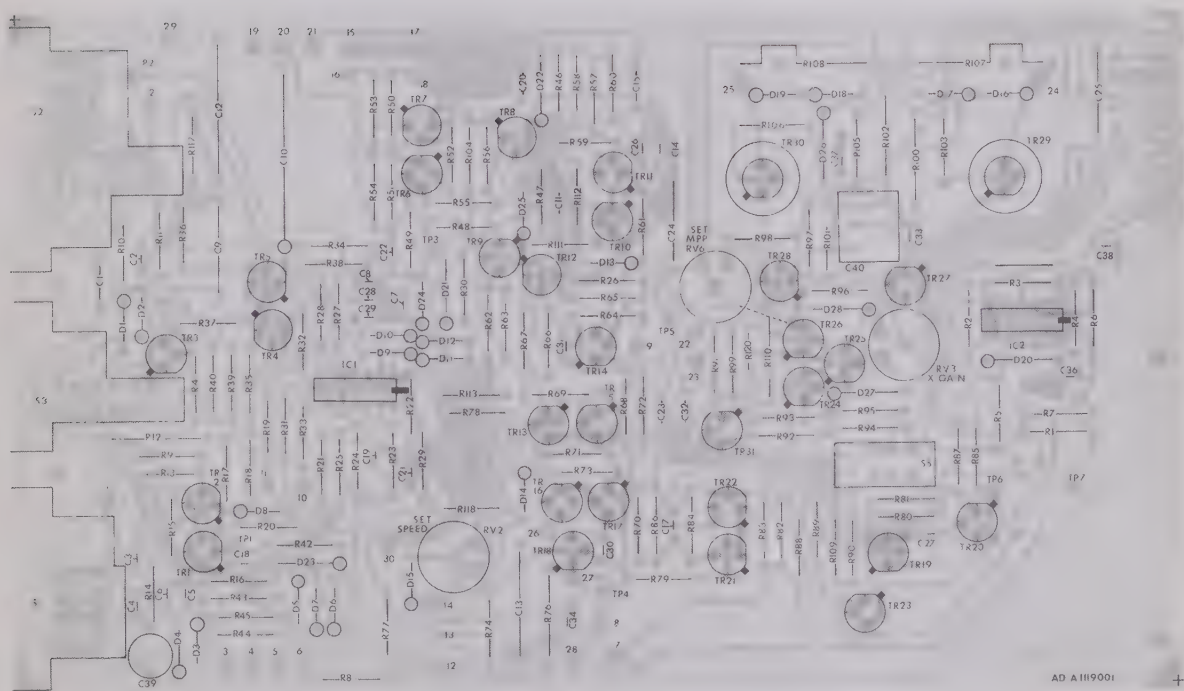


Fig. 10.12 PCB no. 1 (Component Side)

## Detailed Description of Block RIA

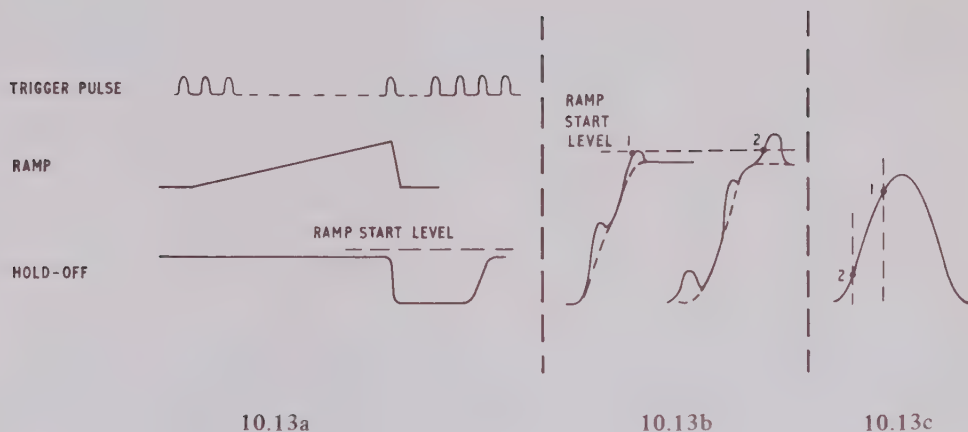


Fig. 10.13

### Introduction

Most modern designs of timebase incorporate a hold-off system to allow the circuitry to reach its quiescent state between end of ramp and the next trigger pulse. However, as neither the trigger pulse low-high transition nor the hold-off transition occur instantaneously, there is a condition where jitter may occur. This condition is outlined in Fig. 10.13, and is most noticeable at high countdown rates.

Consider the conditions at the end of hold-off. The hold-off level rises, ready for the next trigger pulse to initiate the ramp. Ramp start will occur when the trigger pulse, superimposed on the hold-off level, reaches the switching level of the ramp initiation bistable. Two possible conditions are illustrated in Fig. 10.13b; these are equivalent to the ramp triggering at point 1 or point 2 on Fig. 10.13c.

One method of minimising this effect, which is observed as a normal trace accompanied by a ghost trace displaced horizontally, is to ensure that the hold-off and trigger pulse rise-times are very short; for fast timebase speeds, this could be very expensive. A simpler method is to ensure that, if a trigger pulse coincides with the end of hold-off, it does not trigger the timebase. This is the principle of the A100 anti-jitter circuit.

During hold-off time, TR10 draws 5.7mA from TR7 collector. As TR7 can only supply a maximum of 5.9mA, there is insufficient current through D25 to allow it to remain in the high current state. TR10 is cut off outside hold-off time, so that once D25 is made to conduct, it remains in conduction until the hold-off signal re-appears.

### Case 1 Hold-Off terminates before Trigger Pulse arrives

The trigger pulse causes TR6 to conduct, and the step applied to the open circuit delay line keeps TR6 in conduction for 12ns. Similarly, TR7 conducts for 5ns. When TR6 conducts, it 'robs' all tail current from the long-tail pair TR8 and TR9. Therefore, TR9 cannot conduct to start the ramp until 12ns after the trigger pulse leading edge. As hold-off has already ended, D25 will be switched from its low-current state to its high current state by the 5ns pulse from TR7. It will remain in that state after the end of the 5ns pulse due to its bistable action, placing TR9 base more negative than TR8 base. At the end of the 12ns period, when tail current is restored, TR9 will conduct, initiating the ramp. D25 will reset to its low state when the next hold-off period starts.

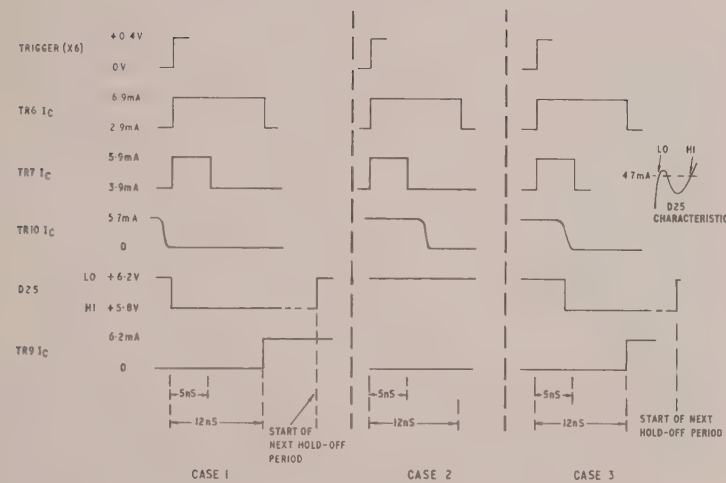


Fig. 10.14 Block RIA Waveforms

#### Case 2 Hold-Off terminates after 5ns delay

As before, the trigger pulse causes TR6 to conduct for 12ns, ensuring TR9 is cut off, and TR7 conducts for 5ns. In this case, the hold-off is still operative, so that D25 cannot switch. After 5ns, TR7 cuts off; TR9 base will remain less negative than TR8 base, so TR9 remains cut off. Thus the trigger pulse is lost, which is the intention of the hold-off circuit.

#### Case 3 Hold-Off terminates during the 5ns delay time

This is the critical case, where jitter could occur if measures were not taken to prevent it. The trigger pulse again inhibits TR9 for 12ns. If termination of hold-off occurs at any time during the 5ns conduction period of TR7, D25 will switch, and conditions at case 1 apply. If end of hold-off and the end of the 5ns pulse coincide, D25 may or may not switch, depending on the exact time relationship between the two events. However, the only result of this indecision is that the ramp may or may not start at the end of the 12ns fixed delay period. Jitter is thus eliminated.

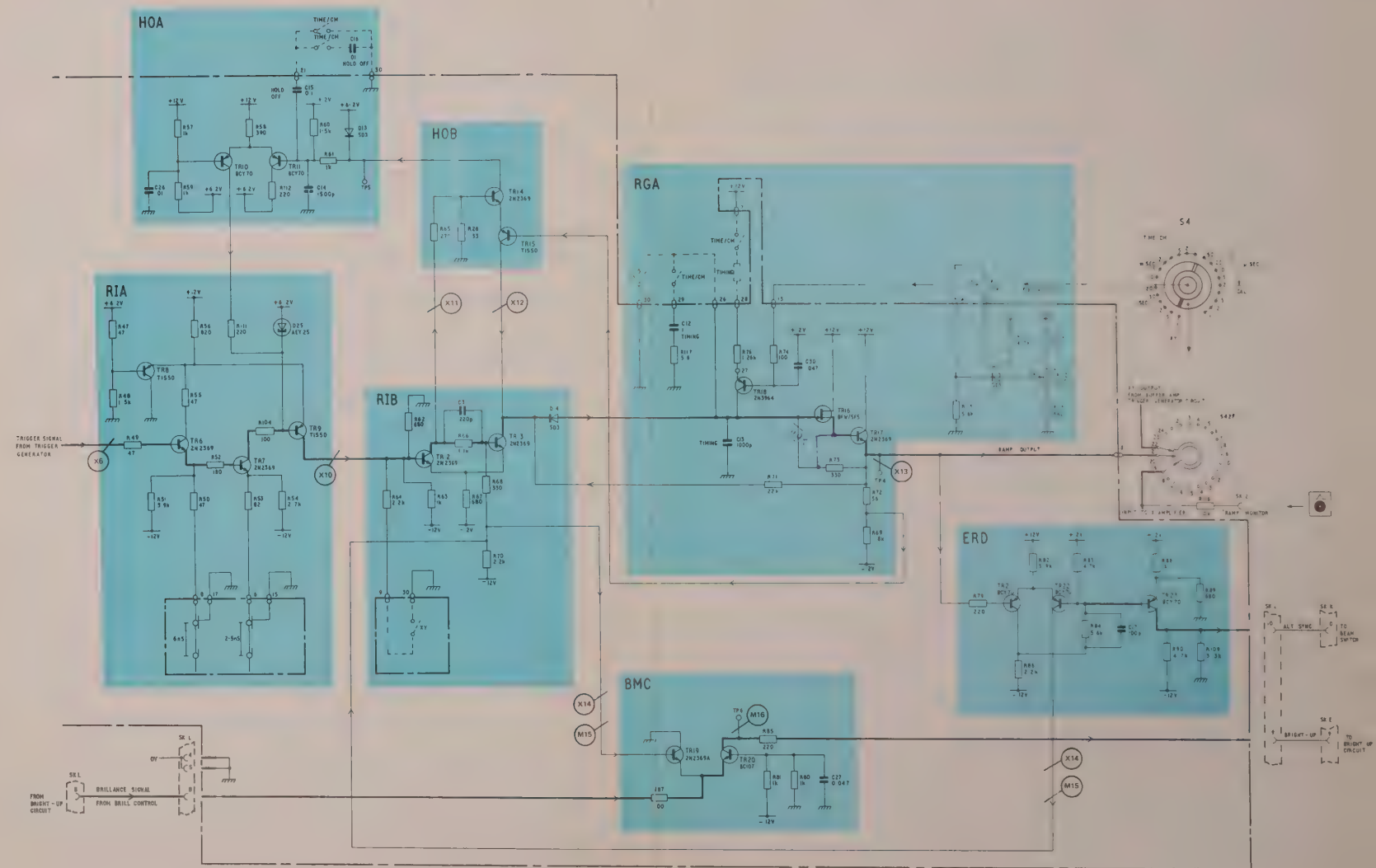
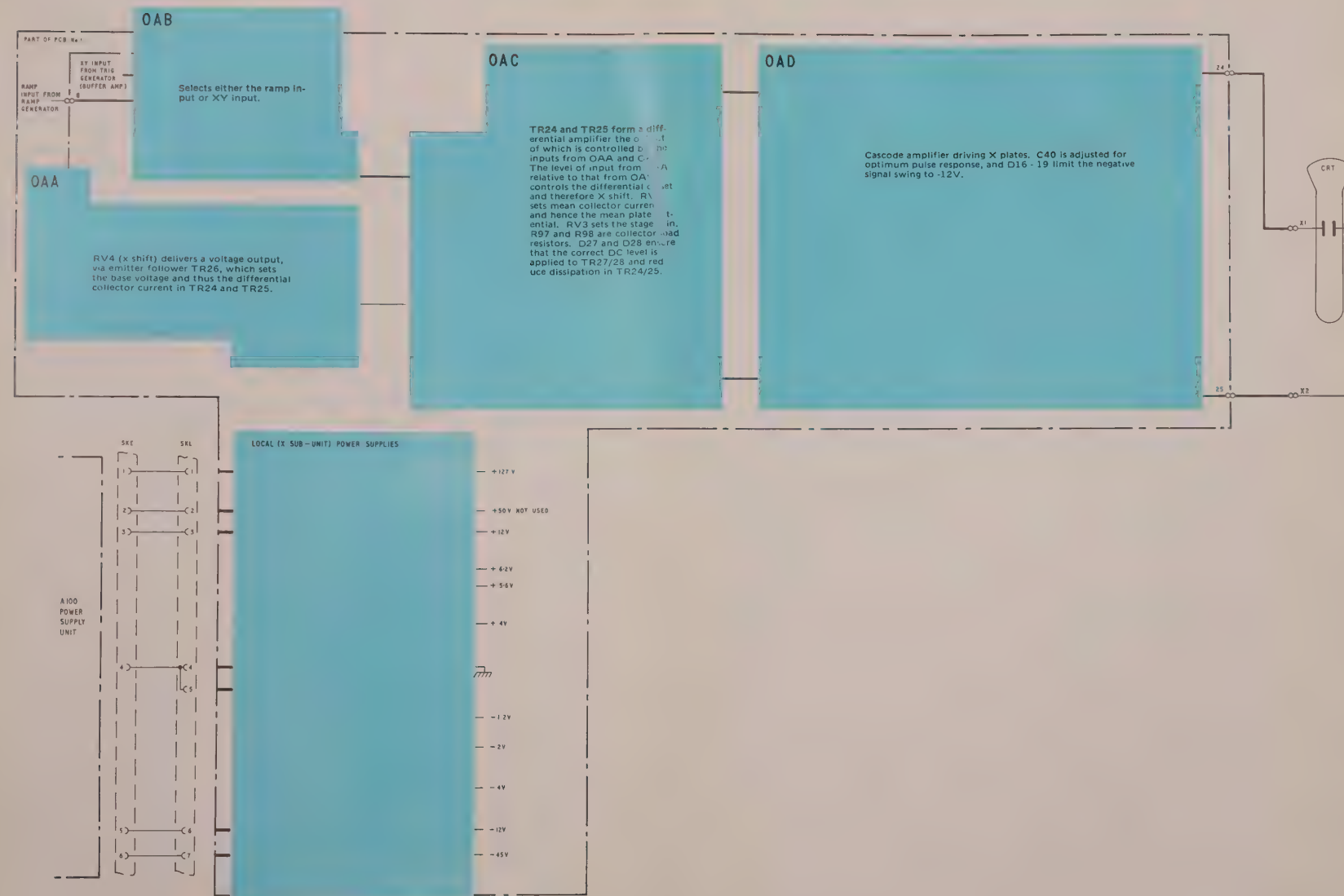


Fig. 10.15 Ramp Generator (DA1117003)



#### Procedure 111 Cal 1

Mean plate potential.

1. Connect AVO between X plates. Select XY and adjust X shift control for zero volts reading.
2. Transfer negative AVO lead to chassis. Adjust RV6 to obtain a reading of  $40V \pm 1V$ .

#### Procedure 111 Cal 2

Horizontal gain and LF pulse response.

1. Select XY on TIME/CM switch, DC trigger coupling, and EXT on trigger selector.
2. Connect 1kHz output of Bradley 192 or 156 at 4V amplitude to EXT X input. Two horizontally opposed spots will appear.
3. Adjust RV3 and X shift control to place the spots behind the 2nd and 10th graticule lines.
4. Switch trigger selector to EXT  $\pm 10$ . Increase square wave signal to 40V amplitude.
5. Adjust C39 to remove any feathering around the spots.

#### Procedure 111 Cal 4

HF pulse response and sweep speed check.

1. Set TIME/CM switch to  $0.1\mu s/cm$ , with X5 expansion.
2. Apply 50MHz signal from Bradley 192 or 156 to Y input.
3. Adjust C40 to obtain maximum accuracy over the centre 8cm.
4. Return expansion switch to X1. Check all sweep speeds for specified accuracy using time markers from Bradley 192 or 156. If necessary, readjust RV2 to bring all speeds within specification.

Fig. 10.16 Output Amplifier and Local Supplies Block Diagram

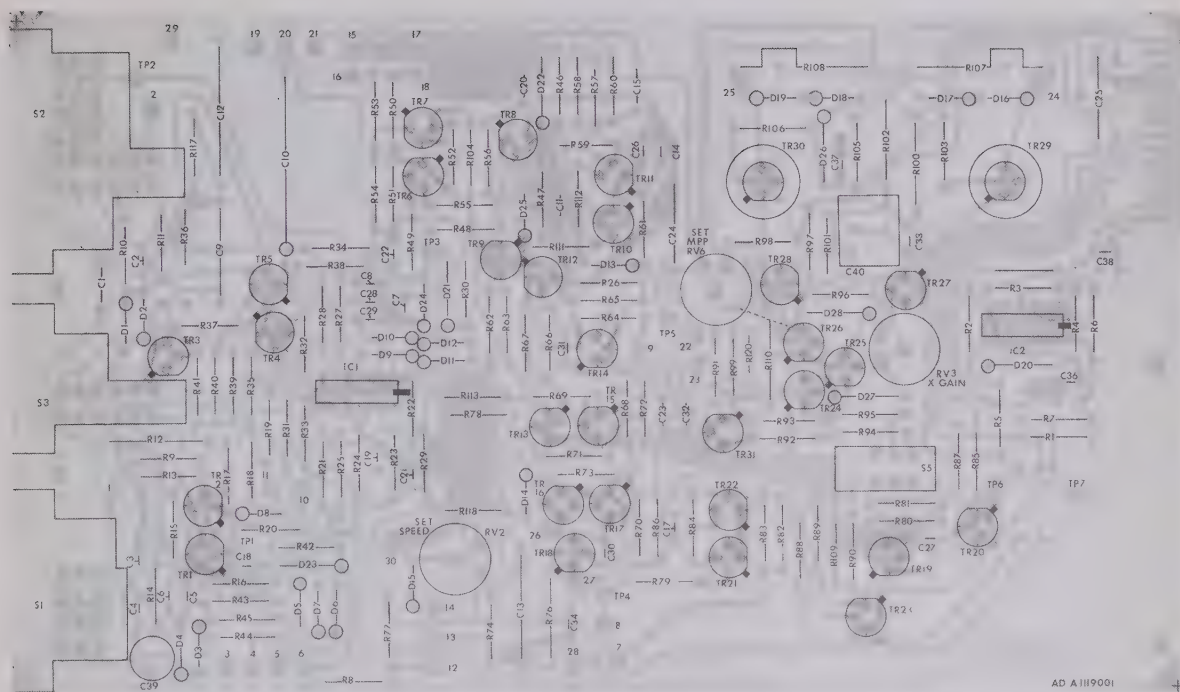


Fig. 10.17 PCB no. 1 (Component Side)

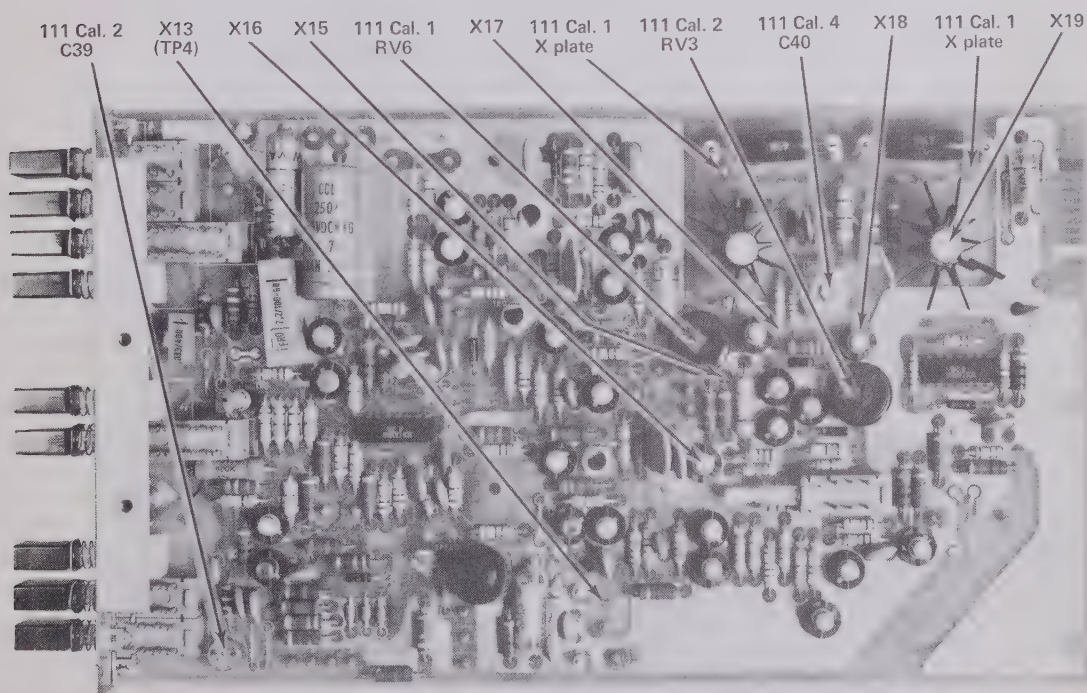


Fig. 10.18 PCB no. 1 (Front Panel Assembly Removed)

Table 10.5 Test Information Points X14 to X19 - Output Amplifier

| Point | Measurement at Standard Settings                                                                                               | Remarks |
|-------|--------------------------------------------------------------------------------------------------------------------------------|---------|
| X14   | <div><div>+ 4 V</div><div>- 1.2 V</div></div> |         |
| X15   | +0.93V                                                                                                                         |         |
| X16   | +4.45V                                                                                                                         |         |
| X17   | <div><div>- 32 V</div><div>- 5 V</div></div>  |         |
| X18   | <div><div>- 23 V</div></div>                  |         |
| X19   | <div><div>+ 90 V</div><div>+ 4 V</div></div>  |         |

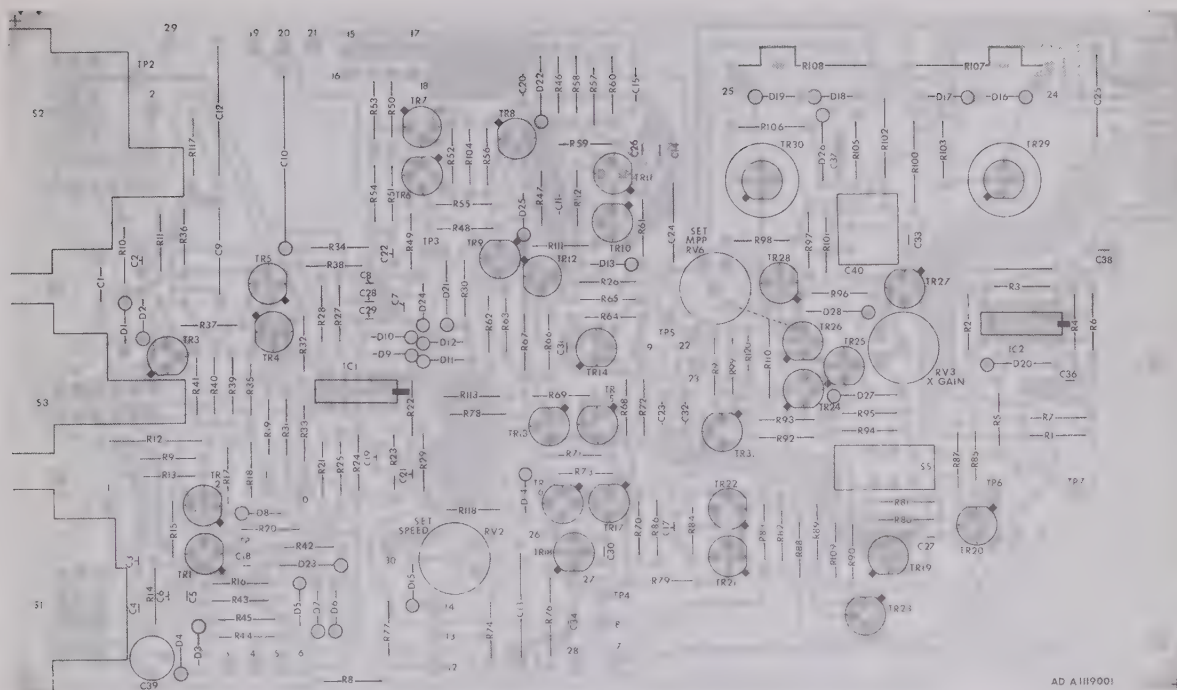


Fig. 10.17 PCB no. 1 (Component Side)

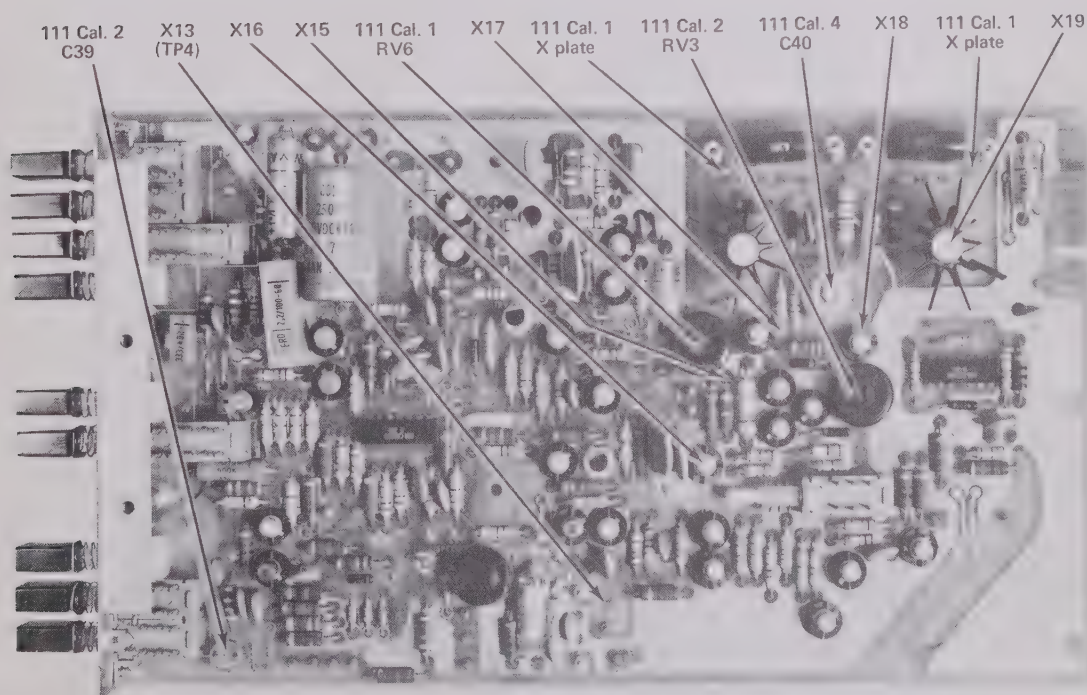


Fig. 10.18 PCB no. 1 (Front Panel Assembly Removed)

Table 10.5 Test Information Points X14 to X19 - Output Amplifier

| Point | Measurement at Standard Settings                                                                                               | Remarks |
|-------|--------------------------------------------------------------------------------------------------------------------------------|---------|
| X14   | <div><div>+ 4 V</div><div>- 1.2 V</div></div> |         |
| X15   | +0.93V                                                                                                                         |         |
| X16   | +4.45V                                                                                                                         |         |
| X17   | <div><div>- 32 V</div><div>- 5 V</div></div>  |         |
| X18   | <div><div>- 23 V</div></div>                  |         |
| X19   | <div><div>+ 90 V</div><div>+ 4 V</div></div>  |         |

# Circuit Notes



Disconnect pin no. 2 of pcb no. 2



Edge connector no. 5 of pcb no. 2



Test information point

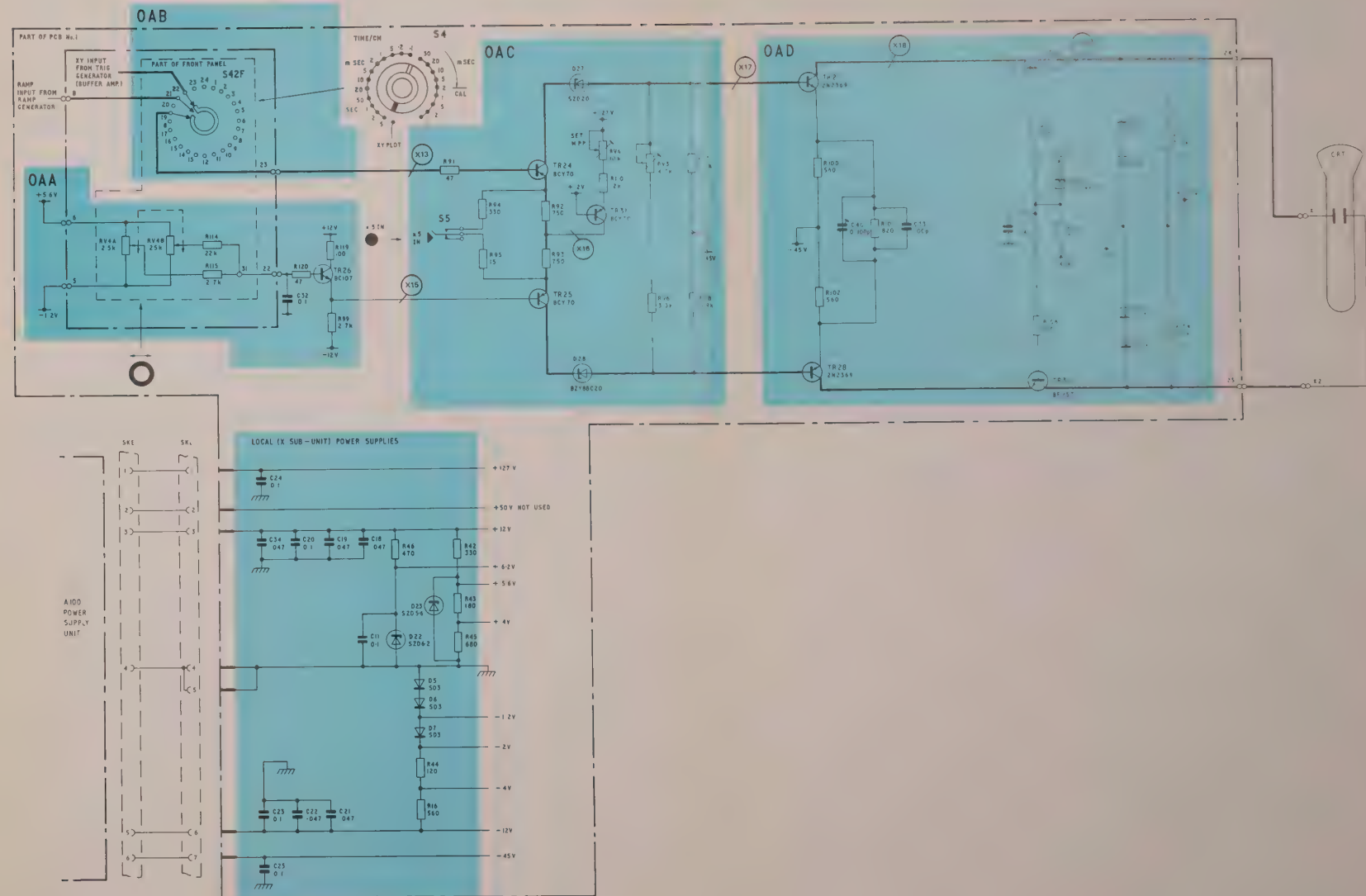
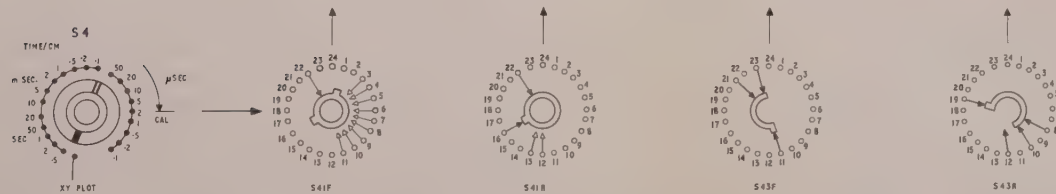
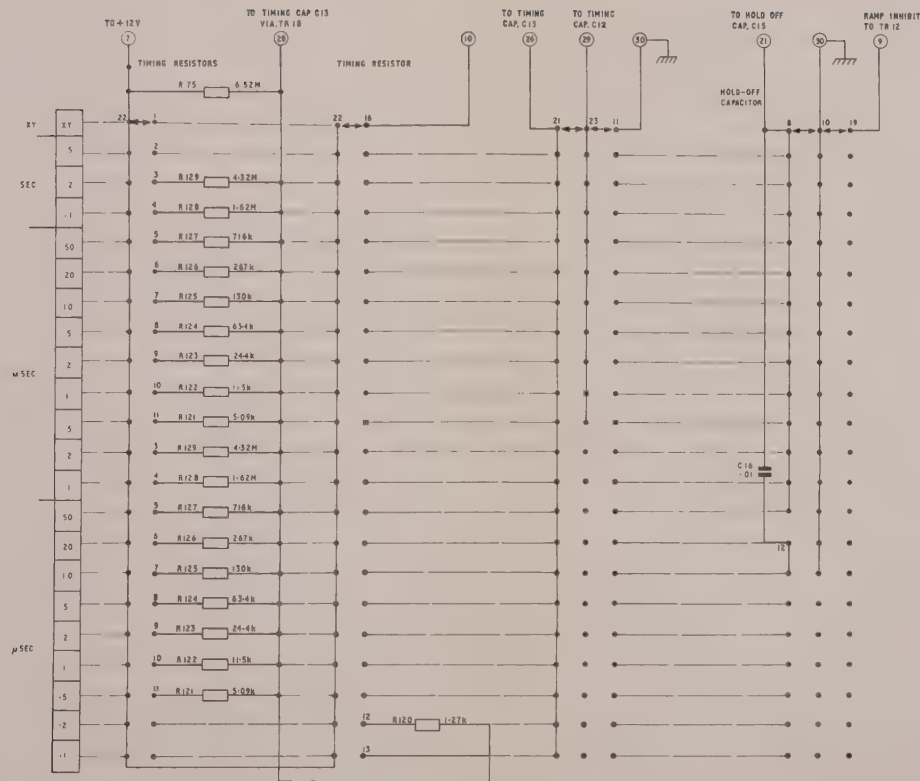


Fig. 10.19 Output Amplifier and Local Supplies (DA1117004)



## COMPONENT PARTS LIST ABBREVIATIONS

### Circuit References

|     |                               |
|-----|-------------------------------|
| B   | Battery                       |
| C   | Capacitor (μF)                |
| CSR | Thyristor                     |
| D   | Diode                         |
| FS  | Fuse                          |
| IC  | Integrated Circuit            |
| L   | Inductor                      |
| LP  | Lamp (including Neon)         |
| LK  | Link                          |
| M   | Meter                         |
| MSP | Mains Selector Panel          |
| PL  | Plug                          |
| R   | Resistor (Ω)                  |
| RL  | Relay                         |
| S   | Switch                        |
| SK  | Socket                        |
| T   | Transformer                   |
| TP  | Terminal Post (or Test Point) |
| TR  | Transistor                    |
| V   | Valve                         |
| X   | Other Components              |

### Also Used:-

|     |                         |
|-----|-------------------------|
| RNL | Non Linear Resistor (Ω) |
| RV  | Variable Resistor (Ω)   |

### Component Composition

#### FIXED RESISTORS

|                       |       |
|-----------------------|-------|
| Carbon Composition    | CACP  |
| Carbon Film           | CAF M |
| Cracked Carbon        | CKCA  |
| Metal Film            | MEFM  |
| Metal Oxide           | MEOX  |
| Power Wirewound       | POWW  |
| Precision Wirewound   | PRWW  |
| Temperature Sensitive | TEMP  |
| Thick Film            | TKFM  |
| Thin Film             | TNFM  |
| Voltage Sensitive     | VOLT  |

### Component Composition (Cont'd)

#### VARIABLE RESISTORS

|                                   |       |
|-----------------------------------|-------|
| Wirewound Preset Single Turn      | WAPS  |
| Wirewound Preset Multiturn        | WAPM  |
| Wirewound Front Panel Single Turn | WFP S |
| Wirewound Front Panel Multiturn   | WFP M |
| Carbon Preset Single Turn         | CASP  |
| Carbon Preset Multiturn           | CAPM  |
| Carbon Front Panel Single Turn    | CAF S |
| Carbon Front Panel Multiturn      | CAF M |
| Cermet Preset Single Turn         | CMPS  |
| Cermet Preset Multiturn           | CMPM  |
| Cermet Front Panel Single Turn    | CMF S |
| Cermet Front Panel Multiturn      | CMF M |

#### CAPACITORS

|                       |      |
|-----------------------|------|
| Air                   | AIR  |
| Aluminum Electrolytic | ALME |
| Aluminum Solid        | ALMS |
| Polycarbonate         | CARB |
| Ceramic               | CERM |
| Polyester Foil        | ESTF |
| Polyester Metallised  | ESTM |
| Glass                 | GLAS |
| MICA                  | MICA |
| Metallised Lacquer    | MLAC |
| Paper Foil            | PAPF |
| Paper Metallised      | PAPM |
| PTFE                  | PTFE |
| Polypropylene Film    | PVLF |
| Polystyrene           | STYR |
| Tantalum Dry          | TAND |
| Tantalum Foil         | TANF |
| Tantalum Wet          | TANW |

Column 4 indicates rating (Watts or Volts)  
Column 5 indicates tolerance (%)

## Component Parts List for General Assembly

| Cct. Ref. | General Description | Solartron Part No. |
|-----------|---------------------|--------------------|
| R114      | CACP 22k 1/4 10     | 172342200          |
| R115      | CACP 2.7k 1/4 10    | 172332700          |
| RV1       | CAFS 10k 1/2 20     | 119600501          |
| RV4A/     | CAFS 2.5k 1/2 20    | 119600601          |
| RV5       | CAFS 25k 1/2 20     | 110010054          |
| SKA       | BNC Panel Socket    | 352101300          |
| SKB       | 2m Panel Socket     | 352501590          |
| SW1       | Push Button Switch  | 379601201          |
| SW2       | Push Button Switch  | 379601301          |
| SW3       | Push Button Switch  | 379601101          |

## Component Parts List for Timebase Switch Assembly

| Cct. Ref. | General Description  | Solartron Part No. |
|-----------|----------------------|--------------------|
| R75       | MEFM 6.52 1 .5       | 160400489          |
| R116      | CACP 10k 1/4 10      | 172341000          |
| R120      | MEFM 1.27k 1/4 .5    | 198331271          |
| R121      | MEFM 5.09k 1/4 .5    | 198235091          |
| R123      | MEFM 24.4k 1/4 .5    | 198242441          |
| R124      | MEFM 63.4k 1/4 .5    | 198246341          |
| R125      | MEFM 130k 1/4 .5     | 198251301          |
| R122      | MEFM 11.5k 1/4 .5    | 198241151          |
| R123      | MEFM 24.4k 1/4 .5    | 198242441          |
| R124      | MEFM 63.4k 1/4 .5    | 198246341          |
| R125      | MEFM 130k 1/4 .5     | 198251301          |
| R126      | MEFM 267k 1/4 .5     | 198252671          |
| R127      | MEFM 716k 1/4 .5     | 198557161          |
| R128      | MEFM 1.62M 1/4 .5    | 198561621          |
| R129      | MEFM 4.32M 1/4 .5    | 160400470          |
| C16       | CERM .01p 25 +50 -20 | 241941000          |

Fig. 10.20 Time/Cm Switch (DA1117005)

| Component Parts List |                     |      |     |    |            | Cct Ref.           | General Description |       |      |     | Solartron Part No. |           |
|----------------------|---------------------|------|-----|----|------------|--------------------|---------------------|-------|------|-----|--------------------|-----------|
| for                  |                     |      |     |    |            |                    |                     |       |      |     |                    |           |
| PCB No.1 (A1119001)  |                     |      |     |    |            | R65                | MEOX                | 270   | 1/2  | 1   | 195422700          |           |
|                      |                     |      |     |    |            | R66                | MEOX                | 1.1k  | 1/2  | 1   | 195431100          |           |
|                      |                     |      |     |    |            | R67                | MEOX                | 680   | 1/2  | 1   | 195426800          |           |
|                      |                     |      |     |    |            | R68                | MEOX                | 330   | 1/2  | 5   | 193523300          |           |
|                      |                     |      |     |    |            | R69                | CACP                | 1.8k  | 1/4  | 10  | 172331800          |           |
| Cct. Ref.            | General Description |      |     |    |            | Solartron Part No. | R70                 | MEOX  | 2.2k | 1/2 | 1                  | 195432200 |
|                      |                     |      |     |    |            |                    | R71                 | CACP  | 22k  | 1/4 | 10                 | 172342200 |
|                      |                     |      |     |    |            |                    | R72                 | CACP  | 56   | 1/4 | 10                 | 172315600 |
|                      |                     |      |     |    |            |                    |                     |       |      |     |                    |           |
| R1                   | CACP                | 1k   | 1/4 | 10 | 172331000  |                    |                     |       |      |     |                    |           |
| R2                   | MEOX                | 820  | 1/2 | 1  | 195428200  | R73                | MEOX                | 330   | 1/2  | 5   | 193523300          |           |
| R3                   | MEOX                | 820  | 1/2 | 1  | 195428200  | R74                | CACP                | 100   | 1/4  | 10  | 172321000          |           |
| R4                   | MEOX                | 820  | 1/2 | 1  | 195428200  | R76                | MEFM                | 1.26k | 1/4  | .5  | 198231261          |           |
|                      |                     |      |     |    |            | R77                | CACP                | 4.7k  | 1/4  | 10  | 172334700          |           |
| R5                   | CACP                | 27   | 1/4 | 10 | 172312700  |                    |                     |       |      |     |                    |           |
| R6                   | CACP                | 10   | 1/4 | 10 | 172311000  | R78                | MEOX                | 560   | 1/2  | 5   | 193525600          |           |
| R7                   | MEOX                | 820  | 1/2 | 1  | 195428200  | R79                | CACP                | 220   | 1/4  | 10  | 172322200          |           |
| R8                   | CACP                | 47   | 1/4 | 10 | 172314700  | R80                | MEOX                | 1k    | 1/2  | 1   | 195431000          |           |
|                      |                     |      |     |    |            | R81                | MEOX                | 1k    | 1/2  | 1   | 195431000          |           |
| R9                   | CACP                | 470k | 1/4 | 10 | 172354700  |                    |                     |       |      |     |                    |           |
| R10                  | CACP                | 33k  | 1/4 | 10 | 172343300  | R82                | MEOX                | 3.9k  | 1/2  | 1   | 195433900          |           |
| R11                  | CACP                | 330k | 1/4 | 10 | 172353300  | R83                | MEOX                | 4.7k  | 1/2  | 1   | 195434700          |           |
| R12                  | MEFM                | 900k | 1/2 | 1  | 198659003  | R84                | MEOX                | 5.6k  | 1/2  | 1   | 195435600          |           |
|                      |                     |      |     |    |            | R85                | CACP                | 220   | 1/4  | 10  | 172322200          |           |
| R13                  | MEOX                | 100k | 1/2 | 1  | 195451000  |                    |                     |       |      |     |                    |           |
| R14                  | CACP                | 330k | 1/4 | 10 | 172353300  | R86                | MEOX                | 2.2k  | 1/2  | 1   | 195432200          |           |
| R15                  | CACP                | 100  | 1/4 | 10 | 172321000  | R87                | CACP                | 100   | 1/4  | 10  | 172321000          |           |
| R16                  | CACP                | 560  | 1/4 | 10 | 172325600  | R88                | MEOX                | 1k    | 1/2  | 1   | 195431000          |           |
|                      |                     |      |     |    |            | R89                | MEOX                | 680   | 1/2  | 1   | 195426800          |           |
| R17                  | MEOX                | 390  | 1/2 | 5  | 193523900  |                    |                     |       |      |     |                    |           |
| R18                  | CACP                | 1.5k | 1/4 | 10 | 172331500  | R90                | MEOX                | 4.7k  | 1/2  | 5   | 193534700          |           |
| R19                  | CACP                | 22   | 1/4 | 10 | 172312200  | R91                | CACP                | 47    | 1/4  | 10  | 172314700          |           |
| R20                  | CACP                | 6.8k | 1/4 | 10 | 172336800  | R92                | MEOX                | 750   | 1/2  | 1   | 195427500          |           |
|                      |                     |      |     |    |            | R93                | MEOX                | 750   | 1/2  | 1   | 195427500          |           |
| R21                  | CACP                | 1.8k | 1/4 | 10 | 1723331800 |                    |                     |       |      |     |                    |           |
| R22                  | CACP                | 220  | 1/4 | 10 | 172322200  | R94                | MEOX                | 330   | 1/2  | 1   | 195423300          |           |
| R23                  | MEOX                | 510  | 1/2 | 1  | 195425100  | R95                | MEOX                | 15    | 1/2  | 5   | 193511500          |           |
| R24                  | MEOX                | 1k   | 1/2 | 1  | 195431000  | R96                | CACP                | 3.3k  | 1/4  | 10  | 172333300          |           |
|                      |                     |      |     |    |            | R97                | MEOX                | 3.9k  | 1/2  | 1   | 195433900          |           |
| R25                  | MEOX                | 1k   | 1/2 | 1  | 195431000  |                    |                     |       |      |     |                    |           |
| R26                  | CACP                | 33   | 1/4 | 10 | 172313300  | R98                | MEOX                | 3.9k  | 1/2  | 1   | 195433900          |           |
| R27                  | CACP                | 100  | 1/4 | 10 | 172321000  | R99                | CACP                | 2.7k  | 1/4  | 10  | 172332700          |           |
| R28                  | CACP                | 100  | 1/4 | 10 | 172321000  | R100               | MEOX                | 560   | 1    | 1   | 197525600          |           |
|                      |                     |      |     |    |            | R101               | MEOX                | 820   | 1/2  | 1   | 195428200          |           |
| R29                  | MEOX                | 68   | 1/2 | 5  | 193516800  |                    |                     |       |      |     |                    |           |
| R30                  | MEOX                | 680  | 1/2 | 1  | 195426800  | R102               | MEOX                | 560   | 1    | 1   | 197525600          |           |
| R31                  | MEOX                | 5.6k | 1/2 | 1  | 195435600  | R103               | CACP                | 100   | 1/4  | 10  | 172321000          |           |
| R32                  | MEOX                | 39   | 1/2 | 1  | 195413900  | R104               | CACP                | 100   | 1/4  | 10  | 172321000          |           |
|                      |                     |      |     |    |            | R105               | CACP                | 5.6k  | 1/4  | 10  | 172335600          |           |
| R33                  | MEOX                | 2.7k | 1/2 | 1  | 195432700  |                    |                     |       |      |     |                    |           |
| R34                  | MEOX                | 12k  | 1/2 | 1  | 195441200  | R106               | CACP                | 100   | 1/4  | 10  | 172321000          |           |
| R35                  | MEOX                | 3.9k | 1/2 | 5  | 193533900  | R107               | POWW                | 3.9k  | 6    | 1   | 173633900          |           |
| R36                  | MEOX                | 100  | 1/2 | 5  | 193521000  | R108               | POWW                | 3.9k  | 6    | 1   | 173633900          |           |
|                      |                     |      |     |    |            | R109               | MEOX                | 3.3k  | 1/2  | 5   | 193533300          |           |
| R37                  | MEOX                | 1.8k | 1/2 | 1  | 195431800  |                    |                     |       |      |     |                    |           |
| R38                  | CACP                | 1k   | 1/4 | 10 | 172331000  | R110               | MEOX                | 12k   | 1    | 5   | 193441200          |           |
| R39                  | MEOX                | 3.3k | 1/2 | 1  | 195433300  | R111               | CACP                | 220   | 1/4  | 10  | 172322200          |           |
| R40                  | MEOX                | 3.3k | 1/2 | 1  | 195433300  | R112               | CACP                | 220   | 1/4  | 10  | 172322200          |           |
|                      |                     |      |     |    |            | R113               | CACP                | 5.6k  | 1/4  | 10  | 172335600          |           |
| R41                  | MEOX                | 3.9k | 1/2 | 1  | 195433900  |                    |                     |       |      |     |                    |           |
| R42                  | CACP                | 330  | 1/4 | 10 | 172323300  | R117               | CACP                | 5.6   | 1/4  | 10  | 172305600          |           |
| R43                  | CACP                | 180  | 1/4 | 10 | 172321800  | R118               | MEOX                | 560   | 1/2  | 5   | 193525600          |           |
| R44                  | CACP                | 120  | 1/4 | 10 | 172321200  | R119               | CACP                | 100   | 1/8  | 10  | 172021000          |           |
|                      |                     |      |     |    |            | R120               | CACP                | 100   | 1/8  | 10  | 172021000          |           |
| R45                  | CACP                | 680  | 1/4 | 10 | 172326800  |                    |                     |       |      |     |                    |           |
| R46                  | CACP                | 470  | 1/4 | 10 | 172324700  | RV2                | WWPS                | 220   | 1    | 10  | 110037230          |           |
| R47                  | MEOX                | 47   | 1/2 | 5  | 193514700  | RV3                | CAPS                | 4.7k  | 1/2  | 20  | 136634700          |           |
| R48                  | MEOX                | 1.5k | 1/2 | 1  | 195431500  | RV6                | CAPS                | 10k   | 1/2  | 20  | 136641000          |           |
|                      |                     |      |     |    |            |                    |                     |       |      |     |                    |           |
| R49                  | CACP                | 47   | 1/4 | 10 | 172314700  | C1                 | ESTM                | .033  | 400  | 10  | 226043300          |           |
| R50                  | MEOX                | 47   | 1/2 | 1  | 195414700  | C2                 | CERM                | 220p  | 500  | 20  | 241322200          |           |
| R51                  | MEOX                | 3.9k | 1/2 | 1  | 195433900  | C3                 | CERM                | 68p   | 500  | 20  | 241316800          |           |
| R52                  | CACP                | 180  | 1/4 | 10 | 172321800  | C4                 | CERM                | 1000p | 500  | 20  | 241331000          |           |
|                      |                     |      |     |    |            |                    |                     |       |      |     |                    |           |
| R53                  | MEOX                | 82   | 1/2 | 1  | 195418200  | C5                 | CERM                | .047  | 25   | +50 | 241944700          |           |
| R54                  | MEOX                | 2.7k | 1/2 | 1  | 195432700  |                    |                     |       |      | -20 |                    |           |
| R55                  | CACP                | 47   | 1/4 | 10 | 172314700  | C6                 | CERM                | .047  | 25   | +50 | 241944700          |           |
| R56                  | MEOX                | 820  | 1/2 | 1  | 195428200  |                    |                     |       |      | -20 |                    |           |
|                      |                     |      |     |    |            | C7                 | CERM                | .047  | 25   | +50 | 241944700          |           |
| R57                  | MEOX                | 1k   | 1/2 | 1  | 195431000  |                    |                     |       |      | -20 |                    |           |
| R58                  | MEOX                | 390  | 1/2 | 1  | 195423900  | C8                 | CERM                | .047  | 25   | +50 | 241944700          |           |
| R59                  | MEOX                | 1k   | 1/2 | 1  | 195431000  |                    |                     |       |      | -20 |                    |           |
| R60                  | MEOX                | 1.5k | 1/2 | 1  | 195431500  |                    |                     |       |      |     |                    |           |
|                      |                     |      |     |    |            |                    |                     |       |      |     |                    |           |
| R61                  | MEOX                | 1k   | 1/2 | 1  | 195431000  | C9                 | ESTM                | 2.2   | 100  | 10  | 225462200          |           |
| R62                  | MEOX                | 680  | 1/2 | 1  | 195426800  | C10                | ALME                | 250   | 25   | +50 | 270782500          |           |
|                      |                     |      |     |    |            |                    |                     |       |      | -10 |                    |           |
| R63                  | MEOX                | 1k   | 1/2 | 1  | 195431000  | C11                | CERM                | .1    | 30   | +50 | 242051000          |           |
| R64                  | CACP                | 2.2k | 1/4 | 10 | 172332200  |                    |                     |       |      | -20 |                    |           |
|                      |                     |      |     |    |            | C12                | ESTM                | 1     | 160  | 1   | 220061000          |           |

| Cct.<br>Ref.           | General Description       |        |     |            |  | Solartron<br>Part No. | Cct.<br>Ref. | General Description     |  |  |  |  | Solartron<br>Part No. |
|------------------------|---------------------------|--------|-----|------------|--|-----------------------|--------------|-------------------------|--|--|--|--|-----------------------|
| C13                    | STYR                      | 1000p  | 630 | 1          |  | 210331000             | TR21         | Trans. Sil. PNP BCY70   |  |  |  |  | 300553590             |
| C14                    | CERM                      | 1500p  | 500 | 20         |  | 241331500             | TR22         | Trans. Sil. PNP BCY70   |  |  |  |  | 300553590             |
| C15                    | ESTM                      | .1     | 100 | 10         |  | 225451000             | TR23         | Trans. Sil. PNP BCY70   |  |  |  |  | 300553590             |
| C17                    | CERM                      | 100p   | 500 | 20         |  | 241321000             | TR24         | Trans. Sil. PNP SM6526  |  |  |  |  | 300552990             |
| C18                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             | TR25         | Trans. Sil. PNP SM6526  |  |  |  |  | 300552990             |
| C19                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             | TR26         | Trans. Sil. NPN BC1075  |  |  |  |  | 300553320             |
| C20                    | CERM                      | .1     | 30  | +50<br>-20 |  | 242051000             | TR27         | Trans. Sil. NPN 2N2369A |  |  |  |  | 300552390             |
| C21                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             | TR28         | Trans. Sil. NPN 2N2369A |  |  |  |  | 300552390             |
| C22                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             | TR29         | Trans. Sil. NPN BF257   |  |  |  |  | 300554120             |
| C23                    | CERM                      | .1     | 30  | +50<br>-20 |  | 242051000             | TR30         | Trans. Sil. NPN BF257   |  |  |  |  | 300554120             |
| C24                    | ESTM                      | .1     | 160 | 10         |  | 220351000             | TR31         | Trans. Sil. PNP BCY70   |  |  |  |  | 300553590             |
| C25                    | ESTM                      | .1     | 160 | 10         |  | 220351000             | IC1          | 14 lead DIL SL3045      |  |  |  |  | 300554090             |
| C26                    | CERM                      | .01    | 25  | +50<br>-20 |  | 241941000             | IC2          | 14 lead DIL SL3045      |  |  |  |  | 300554090             |
| C27                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             | SW5          | Switch Push Button      |  |  |  |  | 379601001             |
| C28                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             |              |                         |  |  |  |  |                       |
| C29                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             |              |                         |  |  |  |  |                       |
| C30                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             |              |                         |  |  |  |  |                       |
| C31                    | CERM                      | 220p   | 500 | 20         |  | 241322200             |              |                         |  |  |  |  |                       |
| C32                    | CERM                      | .1     | 30  | +50<br>-20 |  | 242051000             |              |                         |  |  |  |  |                       |
| C33                    | CERM                      | 100p   | 500 | 20         |  | 241321000             |              |                         |  |  |  |  |                       |
| C34                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             |              |                         |  |  |  |  |                       |
| C35                    | CERM                      | 1000p  | 500 | +20        |  | 241331600             |              |                         |  |  |  |  |                       |
| C36                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             |              |                         |  |  |  |  |                       |
| C37                    | CERM                      | .047   | 25  | +50<br>-20 |  | 241944700             |              |                         |  |  |  |  |                       |
| C38                    | CERM                      | 150p   | 500 | 20         |  | 241321500             |              |                         |  |  |  |  |                       |
| C39                    | PYLN                      | 2-22p  |     |            |  | 290030180             |              |                         |  |  |  |  |                       |
| C40                    | PTFE                      | 4-104p |     |            |  | 290030130             |              |                         |  |  |  |  |                       |
| D1<br>to<br>D19<br>D20 | Diode SD3                 |        |     |            |  | 300522160             |              |                         |  |  |  |  |                       |
| D21                    | BZY88 C6V2                |        |     |            |  | 300521240             |              |                         |  |  |  |  |                       |
| D22                    | BZY88 C6V2                |        |     |            |  | 300521240             |              |                         |  |  |  |  |                       |
| D23                    | BZY88 C5V6                |        |     |            |  | 300521450             |              |                         |  |  |  |  |                       |
| D24                    | Tunnel Diode AEY25        |        |     |            |  | 300524710             |              |                         |  |  |  |  |                       |
| D25                    | Tunnel Diode AEY25        |        |     |            |  | 300524710             |              |                         |  |  |  |  |                       |
| D26                    | BZY88 C12                 |        |     |            |  | 300521480             |              |                         |  |  |  |  |                       |
| D27                    | BZY88 C20                 |        |     |            |  | 300523790             |              |                         |  |  |  |  |                       |
| D28                    | BZY88 C20                 |        |     |            |  | 300523790             |              |                         |  |  |  |  |                       |
| TR1                    | Sil. FET N. Chan. BFW/SF5 |        |     |            |  | 300554060             |              |                         |  |  |  |  |                       |
| TR2                    | Trans. Sil. NPN 2N2369A   |        |     |            |  | 300552390             |              |                         |  |  |  |  |                       |
| TR3                    | Trans. Sil. PNP BCY70     |        |     |            |  | 300553590             |              |                         |  |  |  |  |                       |
| TR4                    | Trans. Sil. NPN BC1075    |        |     |            |  | 300553320             |              |                         |  |  |  |  |                       |
| TR5                    | Trans. Sil. NPN BC1075    |        |     |            |  | 300553320             |              |                         |  |  |  |  |                       |
| TR6                    | Trans. Sil. NPN 2N2369A   |        |     |            |  | 300552390             |              |                         |  |  |  |  |                       |
| TR7                    | Trans. Sil. NPN 2N2369A   |        |     |            |  | 300552390             |              |                         |  |  |  |  |                       |
| TR8                    | Trans. Sil. PNP T1550     |        |     |            |  | 300553720             |              |                         |  |  |  |  |                       |
| TR9                    | Trans. Sil. PNP T1550     |        |     |            |  | 300553720             |              |                         |  |  |  |  |                       |
| TR10                   | Trans. Sil. PNP BCY70     |        |     |            |  | 300553590             |              |                         |  |  |  |  |                       |
| TR11                   | Trans. Sil. PNP BCY70     |        |     |            |  | 300553590             |              |                         |  |  |  |  |                       |
| TR12                   | Trans. Sil. NPN 2N2369A   |        |     |            |  | 300552390             |              |                         |  |  |  |  |                       |
| TR13                   | Trans. Sil. NPN 2N2369A   |        |     |            |  | 300552390             |              |                         |  |  |  |  |                       |
| TR14                   | Trans. Sil. NPN 2N2369A   |        |     |            |  | 300552390             |              |                         |  |  |  |  |                       |
| TR15                   | Trans. Sil. PNP T1550     |        |     |            |  | 300553720             |              |                         |  |  |  |  |                       |
| TR16                   | Sil. FET N. Chan. BFW/SF5 |        |     |            |  | 300554060             |              |                         |  |  |  |  |                       |
| TR17                   | Trans. Sil. NPN 2N2369A   |        |     |            |  | 300552390             |              |                         |  |  |  |  |                       |
| TR18                   | Trans. Sil. PNP BC214LC   |        |     |            |  | 300554150             |              |                         |  |  |  |  |                       |
| TR19                   | Trans. Sil. NPN 2N2369A   |        |     |            |  | 300552390             |              |                         |  |  |  |  |                       |
| TR20                   | Trans. Sil. NPN 2N2369A   |        |     |            |  | 300552390             |              |                         |  |  |  |  |                       |

# SECTION 11 DUAL TIMEBASE A112

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## Introduction (see block diagram, fig 11.4)

The A112 dual timebase is a delayed-sweep generator, capable of generating a sweep at rates between 1.25 sec/cm and 20 ns/cm. The sweep may be delayed by any time period from 20 ns to 0.5 sec by use of the B timebase. For those not familiar with dual timebase circuitry, further details are given below.

The trigger source is selected by one of three push-buttons, labelled INT, EXT and  $\text{EXT} \div 10$ , the signal from the Y module being amplified before selection. The selected signal is passed to a FET input buffer amplifier, which provides a  $1\text{M}\Omega$  input impedance for external trigger and XY plot facilities. If XY is selected on the B timebase switch, this signal then passes to the output amplifier, the intermediate stages being inoperative.

If a timebase speed is selected on the B timebase switch, the trigger signal is passed to the trigger generator. This produces a positive-going edge coincident with the positive- or negative-going edge of the triggering signal, depending on the trigger polarity selection. If "AUTO" is selected, the trigger generator feeds a train of pulses to the timebase in the absence of a triggering signal, thus allowing a baseline to be displayed.

The generated positive-going edge is applied to the B timebase. The B ramp generator, which is used when the single-timebase mode is selected, includes a patented anti-jitter circuit. This eliminates jitter which normally occurs when the end of hold-off is coincident with the trigger pulse leading edge.

The B ramp waveform, when selected, is applied to the output amplifier, through which it drives the X plates. It is also applied to the ramp comparator, which produces a pulse to start the A ramp when the B ramp reaches a level determined by the CM DELAY control. The bright-up signal from each timebase is selected by the delay mode selectors, giving the desired combination of A and B bright-up waveforms to modulate the beam intensity.

The unit also offers single-shot facilities; pressing the "single shot" button disables the normal timebase trigger and sets the timebase to its pre-triggered state. The next trigger pulse will fire the timebase, which is then locked out until the "reset" button is pressed. The timebase again rests until the next trigger pulse.

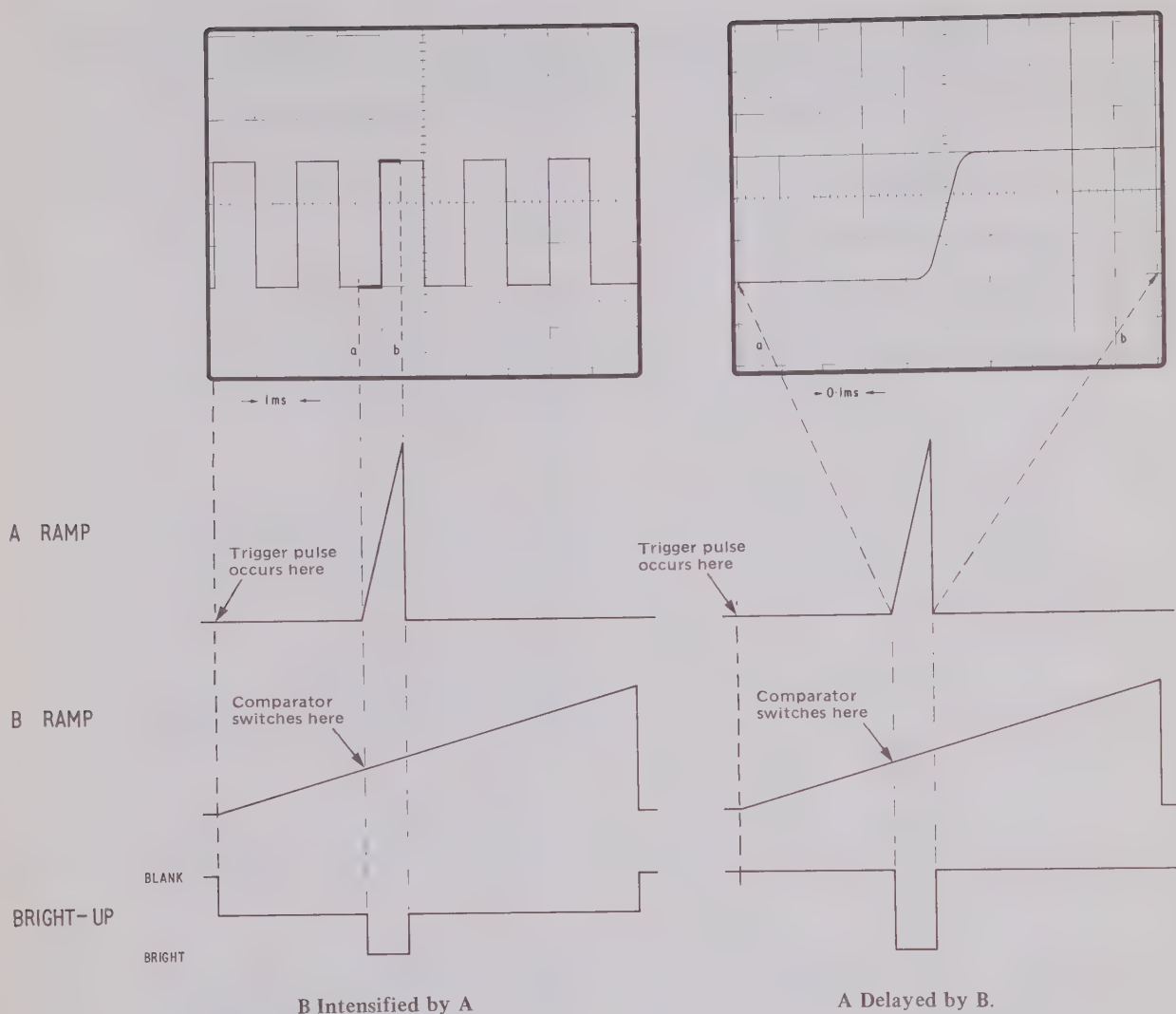


Fig. 11.1 Dual Timebase Waveforms.

## Introduction to Dual Timebase Operation

Suppose it is required to examine a small section of waveform, for example, section a-b in fig. 11.1. One way of achieving this is by centering the portion required on the screen, and expanding the trace horizontally until the required width is obtained. This is satisfactory to a degree as long as the DC conditions are stable, and the expansion gain is accurate. However, expansion of this sort is not very satisfactory when ratios above about 50:1 are used, mainly due to DC drift.

A better method is to use a delay between the trigger pulse and the start of the timebase, and to run the timebase at the rate required to give the necessary horizontal resolution. In fig. 11.1, this would require a delay of 3.5ms, with the timebase running at 100  $\mu$ s/cm. Interpretation of results is greatly simplified if the complete waveform can be displayed, with an identification tag of some description on the section required to be examined in detail.

This is achieved by the dual-timebase system, whose waveform diagrams are shown below the representative traces in fig.11.1. Timebase B is set to display the full waveform, CM DELAY is set to 3.50, and  is pressed. A bright strobe appears, which starts 3.5 cm after the trigger pulse and ends when A ramp has completed its sweep. If a 10:1 expansion is required, as in the right-hand trace of fig.11.1, timebase A is set to run at 10 times the speed of timebase B. Thus, the strobe will run for 1 cm (in fact, the strobe runs for slightly more than 1 cm, but this is unimportant). If  is now pressed the A ramp is applied to the X plates, and the section of the trace which was previously brightened now fills the screen.

By use of the method described above, the required section of waveform has been displayed. Also, the time delay between the trigger pulse and any part of the waveform can be ascertained from the setting of the CM DELAY control.

Outline Calibration Procedure

For a full calibration, adjustments should be made in the order given in table 11.1.

Table 11.1     A112 Calibration

| Procedure | Page  | Description                           | Test Equipment Required |
|-----------|-------|---------------------------------------|-------------------------|
| 112 Cal 1 | 11.20 | Mean plate potential                  | 1                       |
| 112 Cal 2 | 11.20 | Horizontal gain and LF pulse response | 2                       |
| 112 Cal 3 | 11.10 | “B” timebase speed                    | 2                       |
| 112 Cal 4 | 11.16 | “A” timebase speed                    | 2                       |
| 112 Cal 5 | 11.16 | Intensified trace contrast            | –                       |
| 112 Cal 6 | 11.11 | Delay comparator adjustments          | 2                       |
| 112 Cal 7 | 11.20 | HF linearity and sweep speed check    | 2                       |
| 112 Cal 8 | 11.20 | Bandwidth check                       | 3                       |

Test Equipment Requirements

| Item | Description                         | Minimum Specification | Suggested Instrument |
|------|-------------------------------------|-----------------------|----------------------|
| 1    | Multimeter                          | 10KΩ/V                | AVO Model 8          |
| 2    | Oscilloscope calibrator             |                       | Bradley 192 or 156   |
| 3    | Constant amplitude signal generator | 50KHz - 8MHz          | Tektronix 191        |

Standard Settings

The waveforms and voltages at the measuring points in this module were taken from a service-able instrument with the controls set as follows:-

|                       |                                                                                   |
|-----------------------|-----------------------------------------------------------------------------------|
| TIME/CM B             | 0.5ms                                                                             |
| TIME/CM A             | 0.1ms                                                                             |
| B FINE VEL            | CAL                                                                               |
| X5 IN                 | Released                                                                          |
| TRIG coupling         | AC                                                                                |
| Trig polarity         | +                                                                                 |
| Trig source           | INT                                                                               |
| TRIG LEVEL            | Central                                                                           |
| Delay mode selectors  |  |
| Single shot selectors | RUN                                                                               |
| CM DELAY              | 2.00                                                                              |
| Display               | 6cm calibrator signal                                                             |

Servicing Information

Where access is required to pcb no. 2, which contains the “A” timebase, sweep comparator, and single shot circuitry, the module should be removed from the main frame. Fig. 11.3 shows how the module may operate outside the main frame. The module should rest on a sheet of insulating material, e.g. perspex hardboard, etc. Care should be exercised when bending the film wire connector, as rough handling may cause discontinuities in the copper track.

Printed Circuit Board Diagrams

The pcb layout diagrams also show the test information points, whose expected readings are tabulated on an adjacent page. The diagrams of pcb no. 1 show the component layout, superimposed on the copper track of the reverse side, and viewed as though the pcb base material were transparent. Note that, for the sake of clarity, no component-side printed wiring is shown.

Some of the test information points are the collectors of metal-can transistors; in these cases the arrow indicating the test information point terminates at the mounting pad outline of the transistor. Where a test information point indicates one wire of a component, care should be taken to avoid shorting this point to the earth plane under the components.

Pcb no. 2 is normally seen from the printed wiring side; the components are not accessible without removing the board from its mountings. Although this is a simple operation, involving the removal of four screws and two disconnect leads, it is more convenient in fault-finding to leave the board mounted. Accordingly, the layout diagram shows the printed wiring side, with the component numbers indicated in the appropriate places.

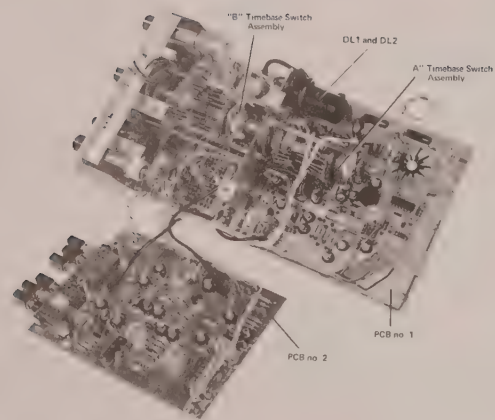


Fig. 11.2 Module with PCB no. 2 Removed - General View.

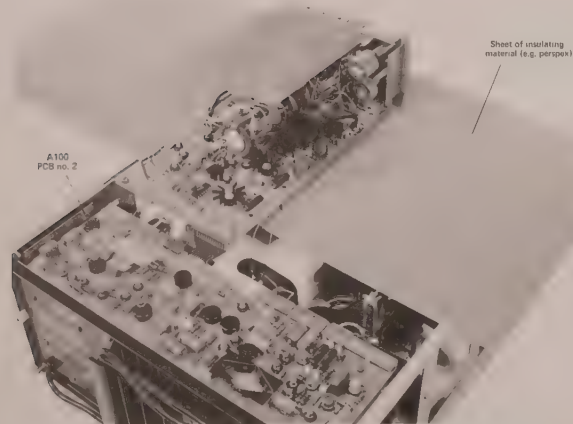


Fig. 11.3 Operation with module removed from Main Frame.

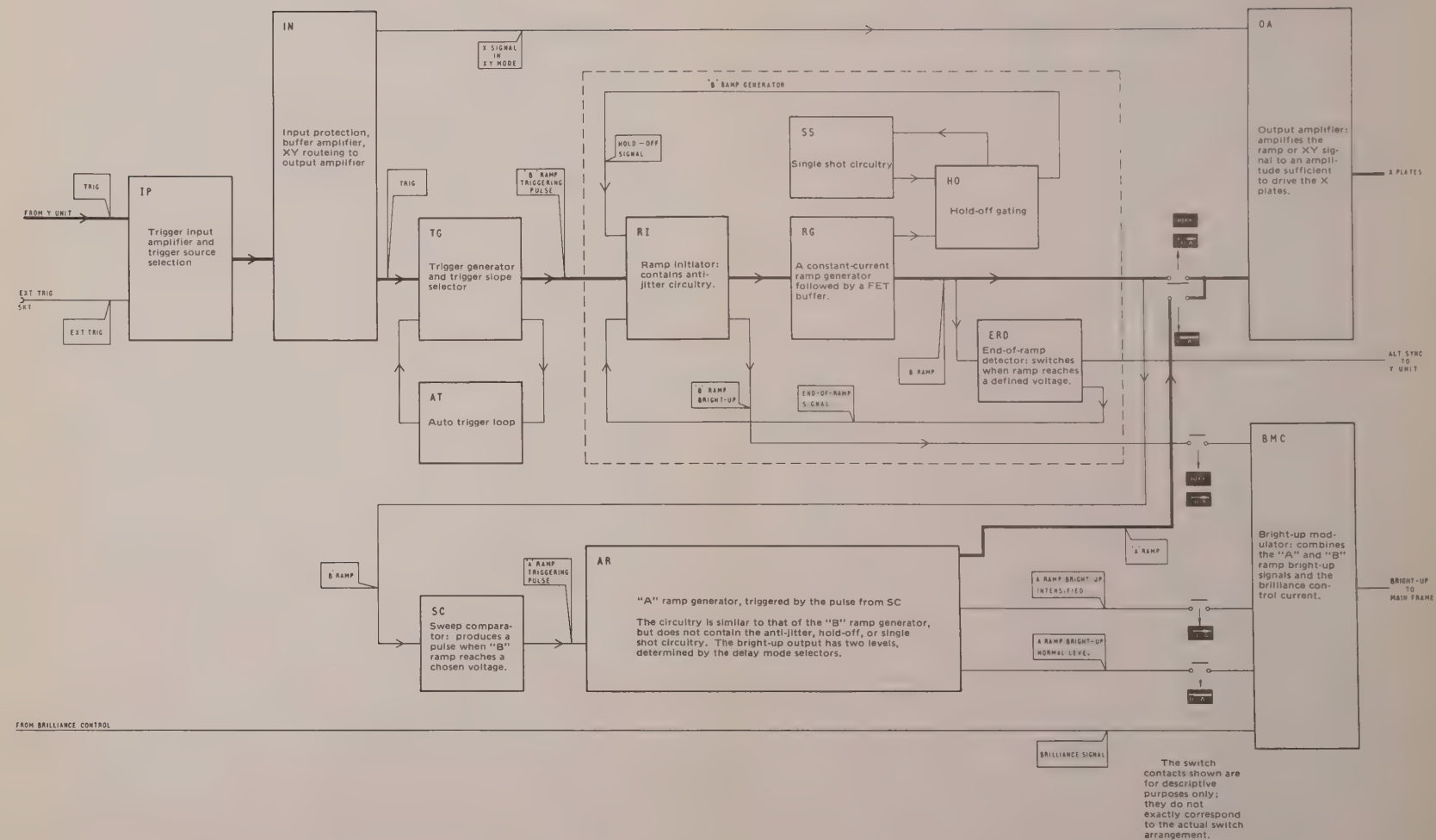
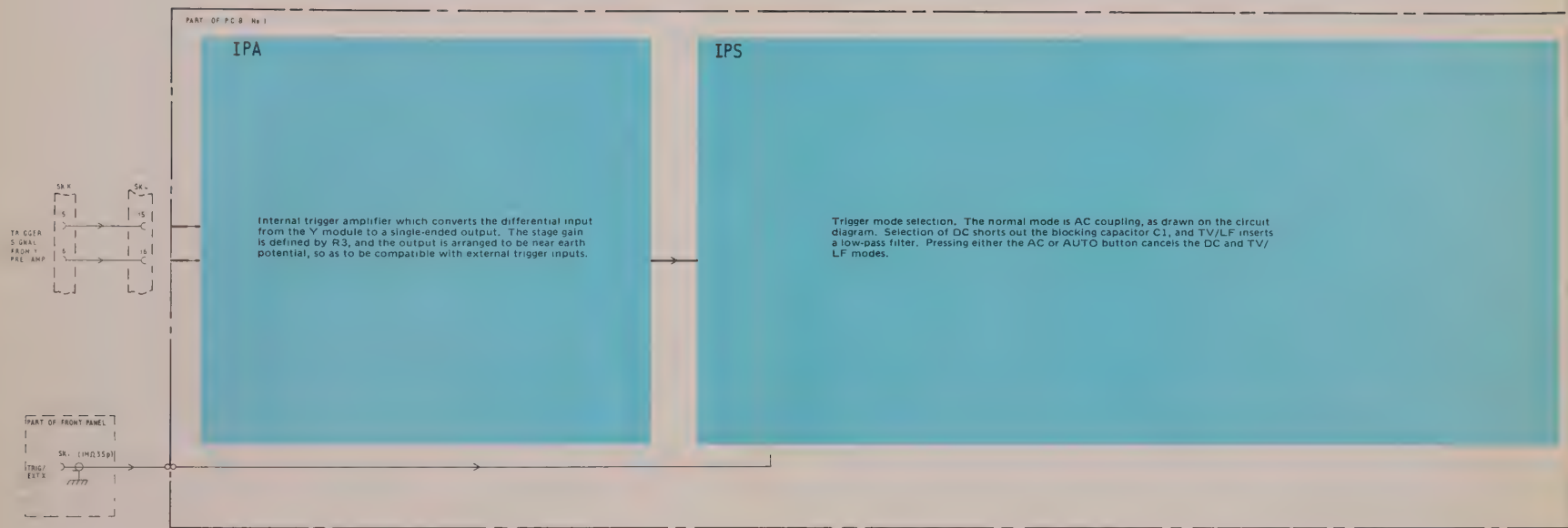


Fig. 11.4 A112 Overall Block Diagram.



# Adjustment of C39

This is part of procedure 112 Cal 2, and is described on page 11 20.

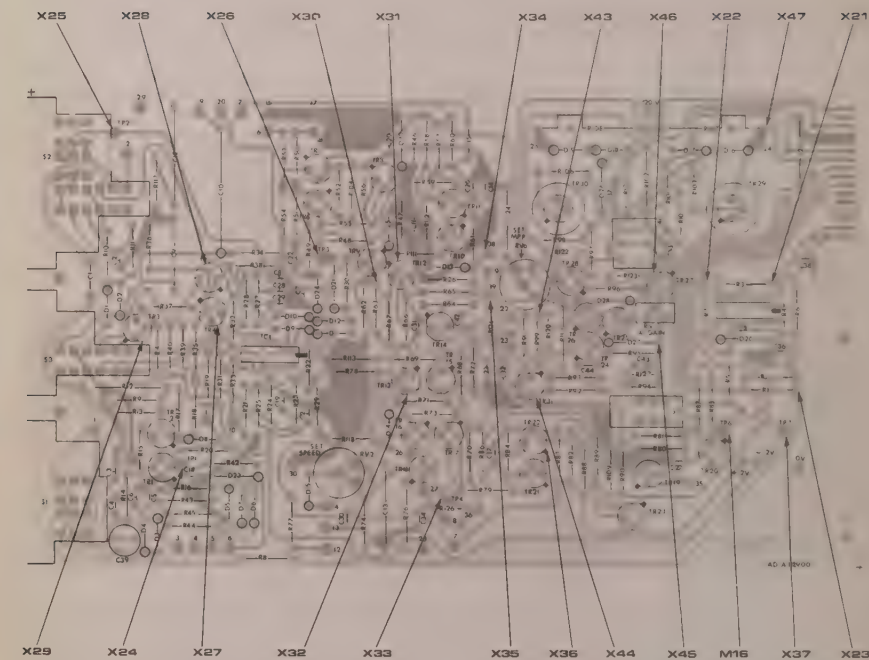


Table 11.3 Test Information Points X24 to X29 - Trigger Generator.

| Point     | Measurement at Standard Settings | Remarks                                                 |
|-----------|----------------------------------|---------------------------------------------------------|
| X24 (TP1) |                                  |                                                         |
| X25 (TP2) |                                  | When AUTO is selected, waveform changes to that of X29. |
| X26 (TP3) |                                  |                                                         |
| X27       |                                  |                                                         |
| X28       |                                  |                                                         |
| X29       |                                  |                                                         |

All waveforms are time-related.

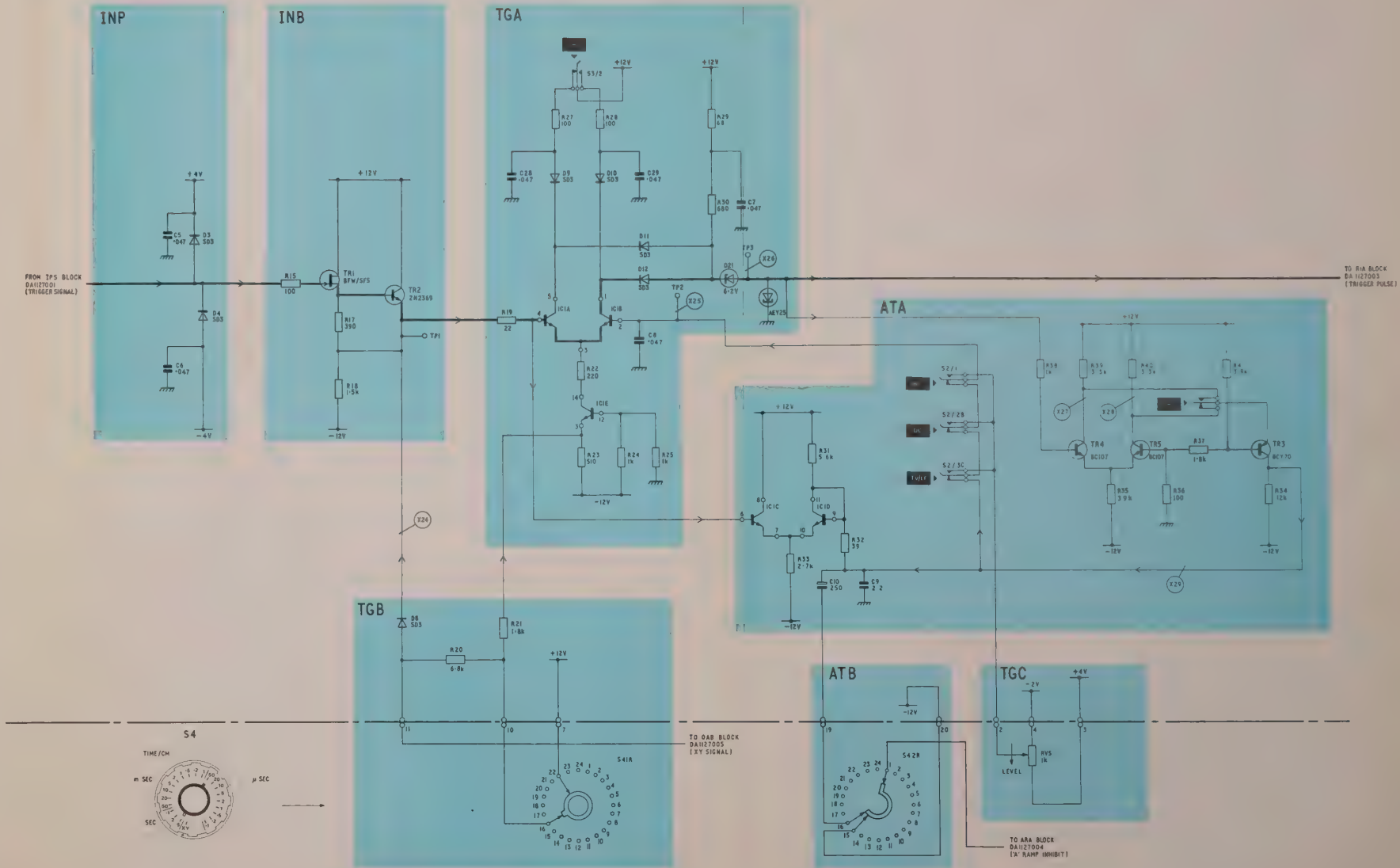
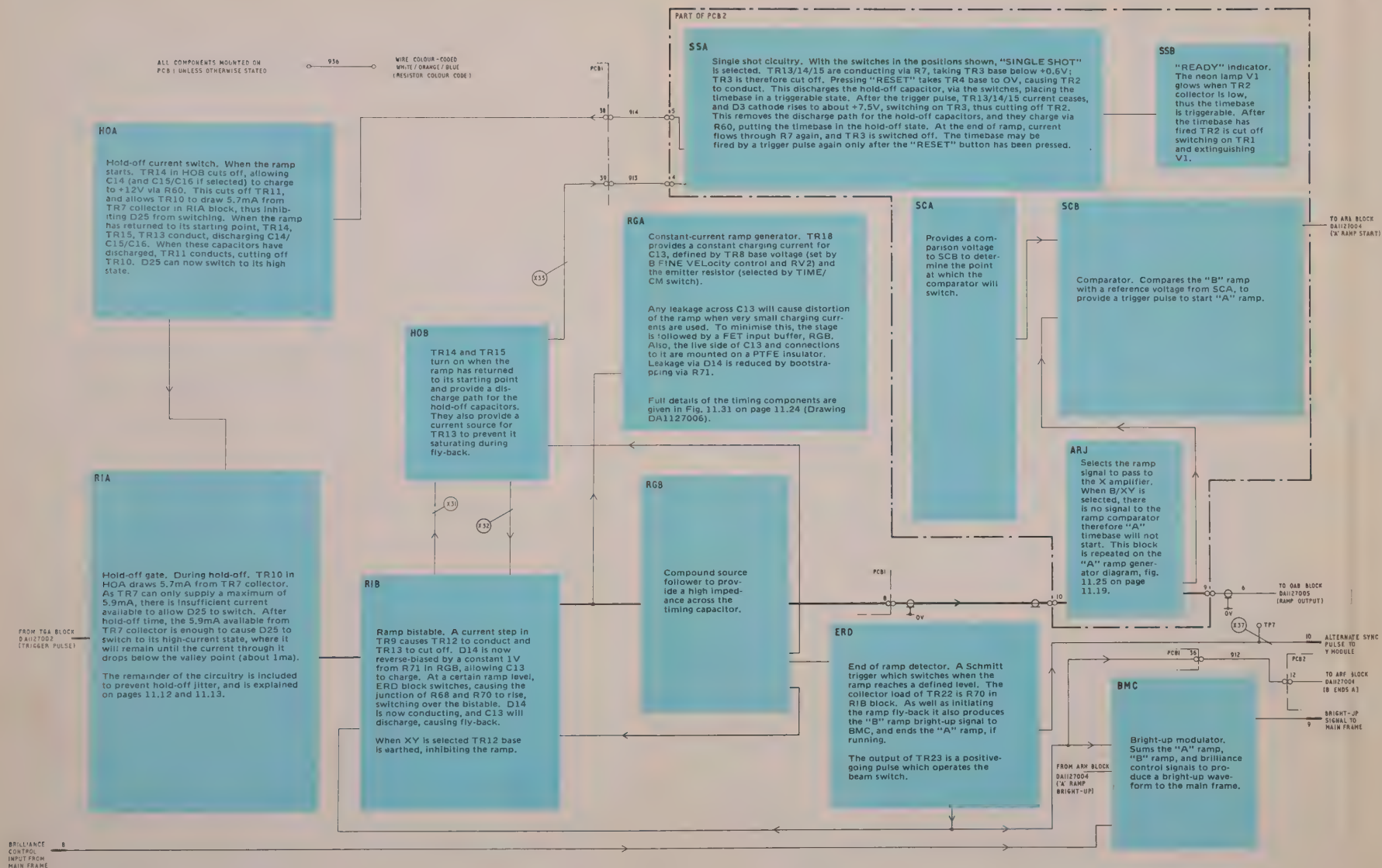


Fig. 11.12 Trigger Generator (DA1127002).



# Procedure 112 Cal 3 "B" timebase speed.

1. Set delay mode selector to B (B/XY on some models). Set B TIME/CM to 0.5ms, and B FINE VEL to CAL. Select INT trigger and AC coupling.
2. Display 2KHz markers from Bradley 192.
3. Adjust RV2 on pcb no. 1 for maximum accuracy over the centre 8cm. RV2 is accessible through a hole in pcb no. 2. See fig. 11.14.

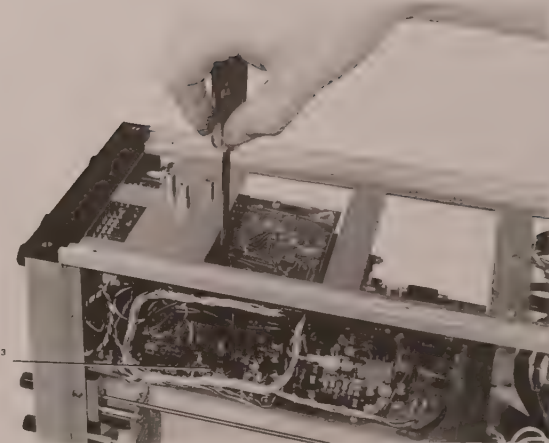


Fig. 11.14 Access to RV2.

Fig. 11.13 "B" Ramp Generator, Sweep Comparator and Single Shot Block Diagram.

**Procedure 112 Cal 6**      Delay comparator adjustments.

1. Set B TIME/CM to 1ms, and A TIME/CM to 50 $\mu$ s; select INT trigger and AC coupling.
2. Remove the button from the front of CM DELAY indicator, slacken the screw and remove the knob. Set indicator reading to 0.30, turn the control shaft fully anticlockwise and replace the knob. Tighten the screw and ensure that the indicator reads 0.30 at anticlockwise limit.
3. Display 0.5ms markers. Set CM DELAY to 0.50.
4. Adjust RV3 so that the bright strobe starts at the leading edge of the second marker.
5. Set CM DELAY to 10.00. Display 1ms markers. Adjust RV4 so that the bright strobe starts at the 11th marker.  
**Note.** On early models, RV4 is only accessible when the module is out of the main frame. See page 11.4. On later models, RV4 is a perpendicular-mounting type, and is accessible from above the pcb without removing the module.
6. Set CM DELAY to 0.50, delay mode selector to "A delayed by B". Display 0.5ms markers and trim the adjustment of RV3 so that the trace starts at the leading edge of the marker.
7. Set CM DELAY to 10.50, and repeat the above adjustment with RV4.

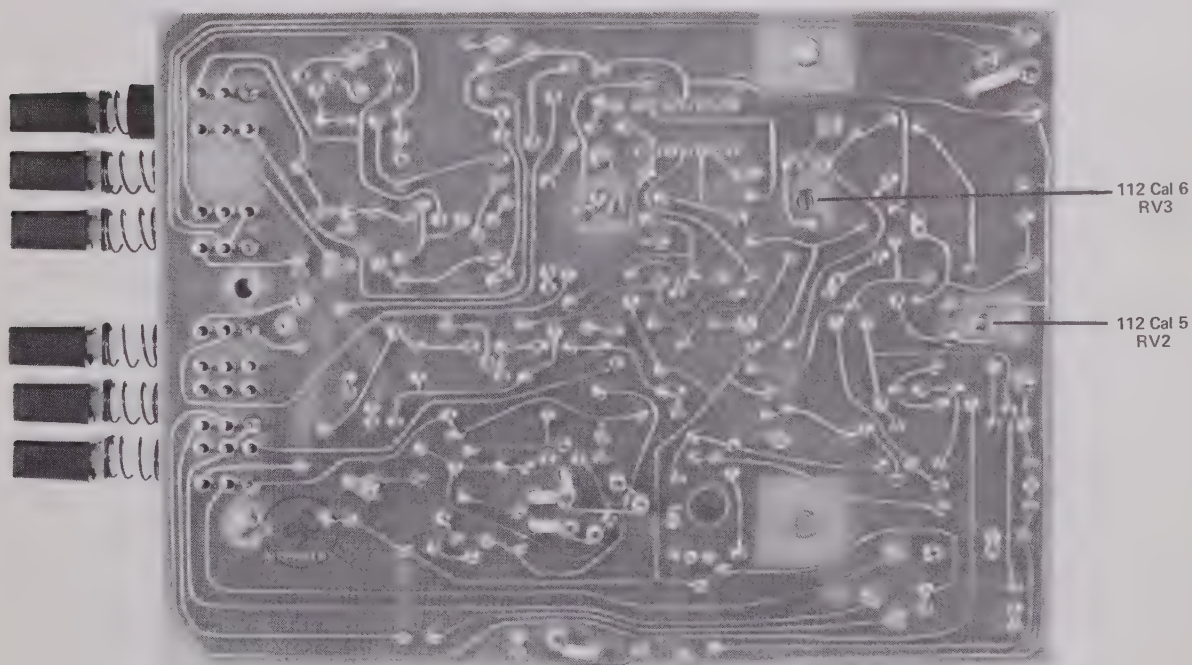


**Fig. 11.15**      **PCB no. 2 Calibration Details.**

## Detailed Description of Block RIA

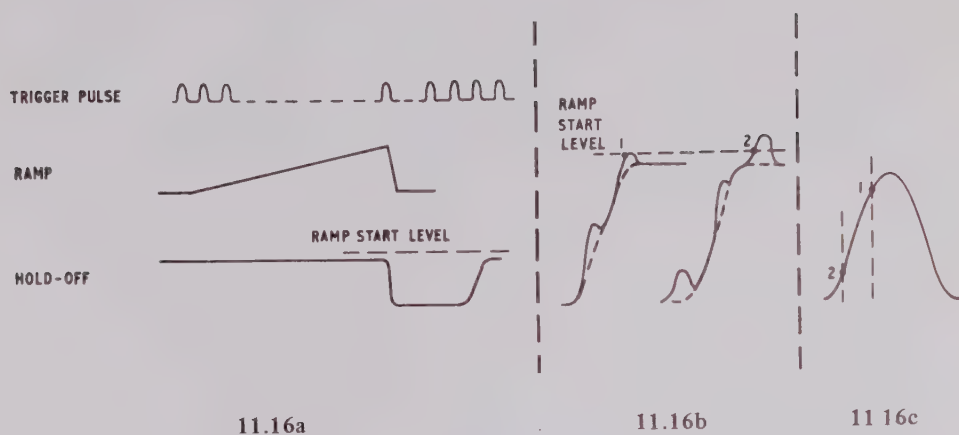


Fig. 11.16

### Introduction

Most modern designs of timebase incorporate a hold-off system to allow the circuitry to reach its quiescent state between end of ramp and the next trigger pulse. However, as neither the trigger pulse low-high transition nor the hold-off transition occur instantaneously, there is a condition where jitter may occur. This condition is outlined in Fig.11.16, and is most noticeable at high countdown rates.

Consider the conditions at the end of hold-off. The hold-off level rises, ready for the next trigger pulse to initiate the ramp. Ramp start will occur when the trigger pulse, superimposed on the hold-off level, reaches the switching level of the ramp initiation bistable. Two possible conditions are illustrated in Fig. 11.16b; these are equivalent to the ramp triggering at point 1 or point 2 on Fig. 11.16c.

One method of minimising this effect, which is observed as a normal trace accompanied by a ghost trace displaced horizontally, is to ensure that the hold-off and trigger pulse rise-times are very short; for fast timebase speeds, this could be very expensive. A simpler method is to ensure that, if a trigger pulse coincides with the end of hold-off, it does not trigger the timebase. This is the principle of the A100 anti-jitter circuit.

During hold-off time, TR10 draws 5.7mA from TR7 collector. As TR7 can only supply a maximum of 5.9mA, there is insufficient current through D25 to allow it to remain in the high current state. TR10 is cut off outside hold-off time, so that once D25 is made to conduct, it remains in conduction until the hold-off signal re-appears.

### Case 1 Hold-Off terminates before Trigger Pulse arrives

The trigger pulse causes TR6 to conduct, and the step applied to the open circuit delay line keeps TR6 in conduction for 12ns. Similarly, TR7 conducts for 5ns. When TR6 conducts, it 'robs' all tail current from the long-tail pair TR8 and TR9. Therefore, TR9 cannot conduct to start the ramp until 12ns after the trigger pulse leading edge. As hold-off has already ended, D25 will be switched from its low-current state to its high current state by the 5ns pulse from TR7. It will remain in that state after the end of the 5ns pulse due to its bistable action, placing TR9 base more negative than TR8 base. At the end of the 12ns period, when tail current is restored, TR9 will conduct, initiating the ramp. D25 will reset to its low state when the next hold-off period starts.

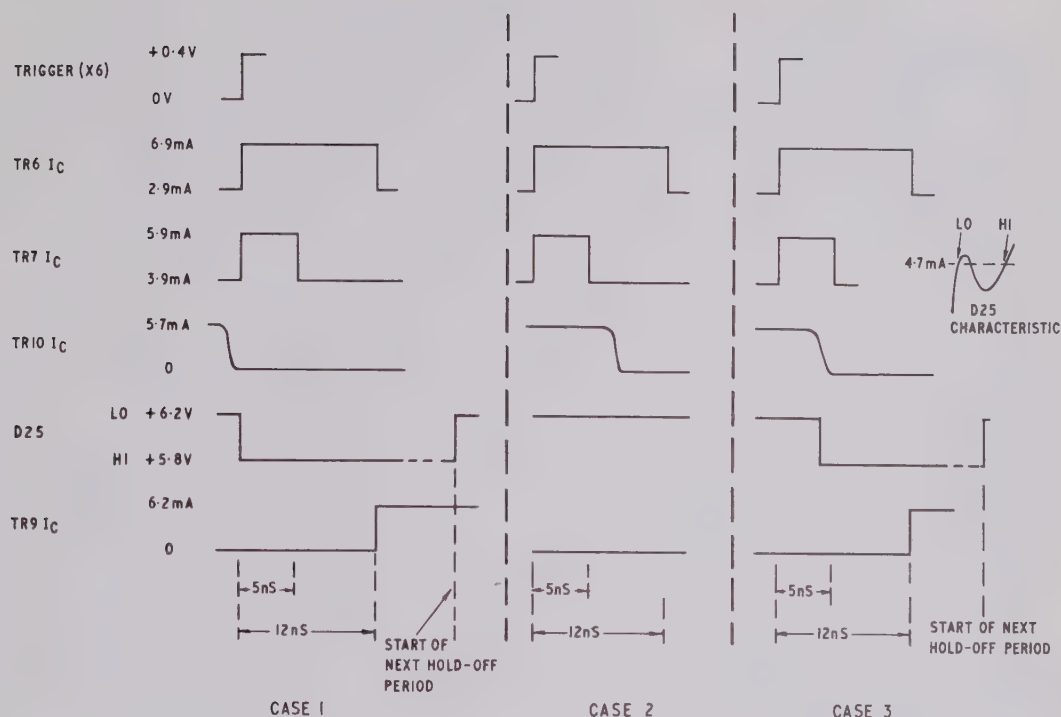


Fig. 11.17 Block RIA waveforms.

#### Case 2 Hold-Off terminates after 5ns delay

As before, the trigger pulse causes TR6 to conduct for 12ns, ensuring TR9 is cut off, and TR7 conducts for 5ns. In this case, the hold-off is still operative, so that D25 cannot switch. After 5ns, TR7 cuts off; TR9 base will remain less negative than TR8 base, so TR9 remains cut off. Thus the trigger pulse is lost, which is the intention of the hold-off circuit.

#### Case 3 Hold-Off terminates during the 5ns delay time

This is the critical case, where jitter could occur if measures were not taken to prevent it. The trigger pulse again inhibits TR9 for 12ns. If termination of hold-off occurs at any time during the 5ns conduction period of TR7, D25 will switch, and conditions at case 1 apply. If end of hold-off and the end of the 5ns pulse coincide, D25 may or may not switch, depending on the exact time relationship between the two events. However, the only result of this indecision is that the ramp may or may not start at the end of the 12ns fixed delay period. Jitter is thus eliminated.

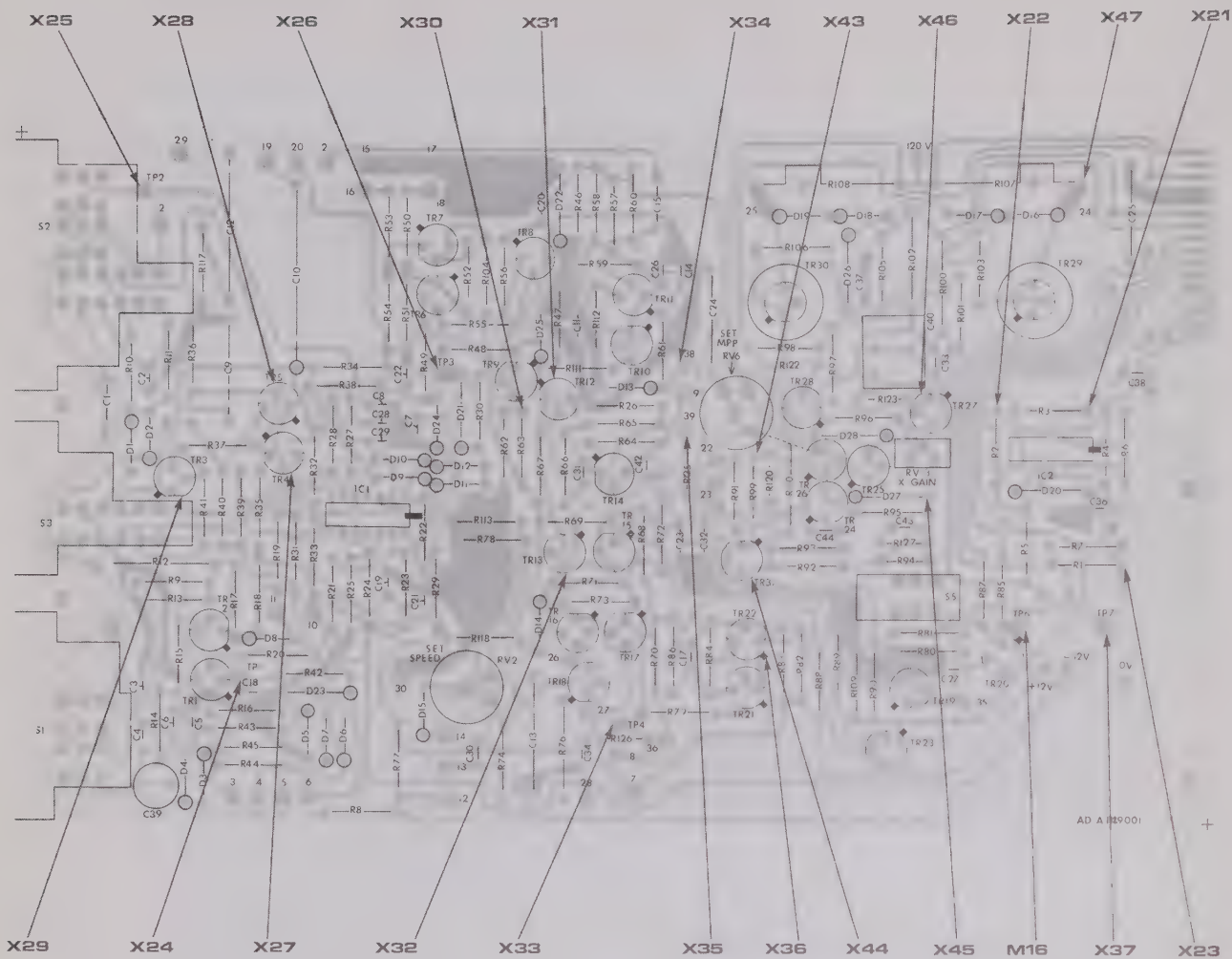


Fig. 11.18 PCB no. 1 (Component Side)

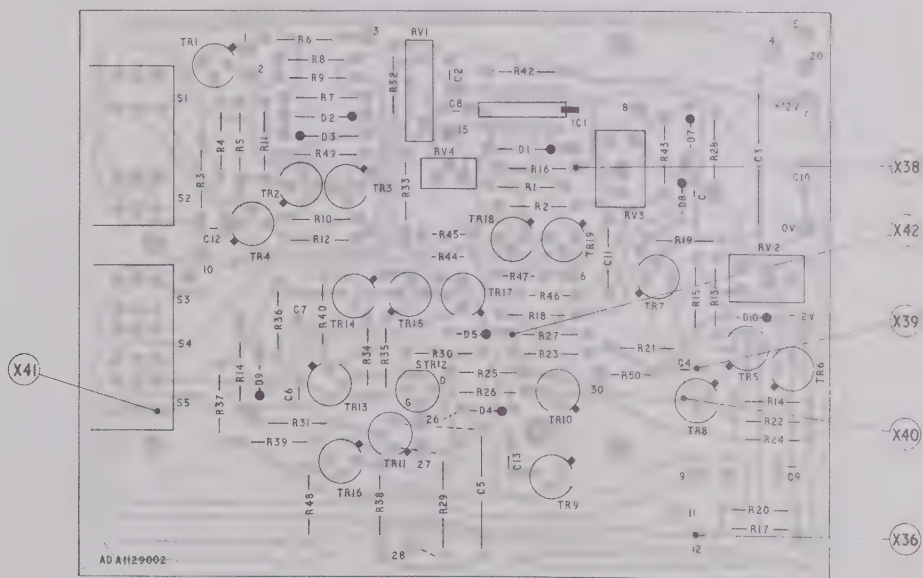


Fig. 11.19 PCB no. 2 (Copper Side)

Table 11.4 Test Information Points X26, X30 to X38, M16 - "B" Ramp Generator

| Point     | Measurement at Standard Settings | Remarks                             |
|-----------|----------------------------------|-------------------------------------|
| X26 (TP3) |                                  |                                     |
| X30       |                                  |                                     |
| X31       |                                  |                                     |
| X32       |                                  |                                     |
| X33 (TP4) |                                  |                                     |
| X34       |                                  | +12V when SINGLE SHOT is selected.  |
| X35       | Same as X34                      | +2.5V when SINGLE SHOT is selected. |
| X36 (M15) |                                  |                                     |
| X37 (TP7) |                                  |                                     |
| X38       |                                  |                                     |
| M16 (TP6) |                                  |                                     |

All waveforms are time-related.

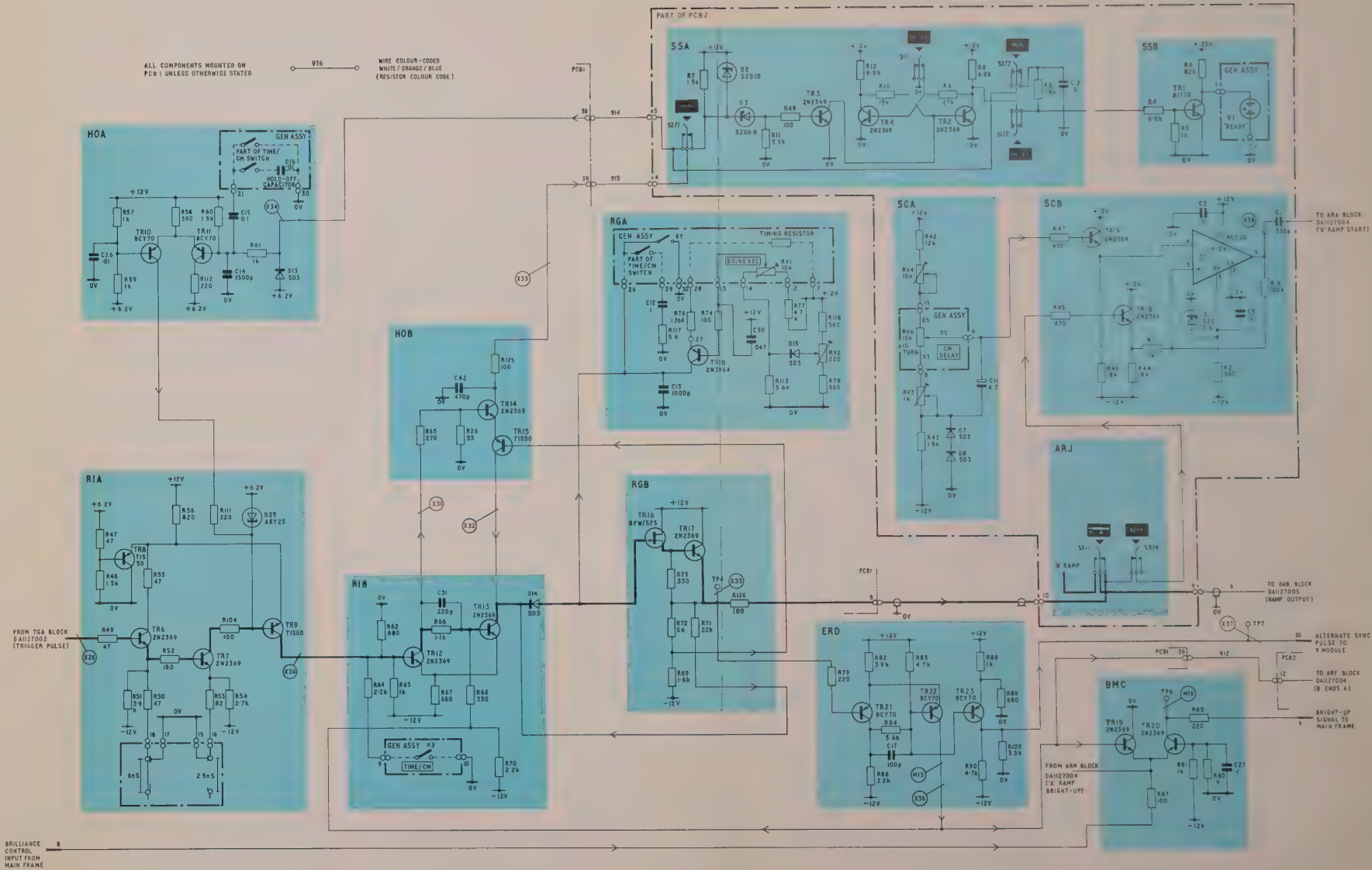
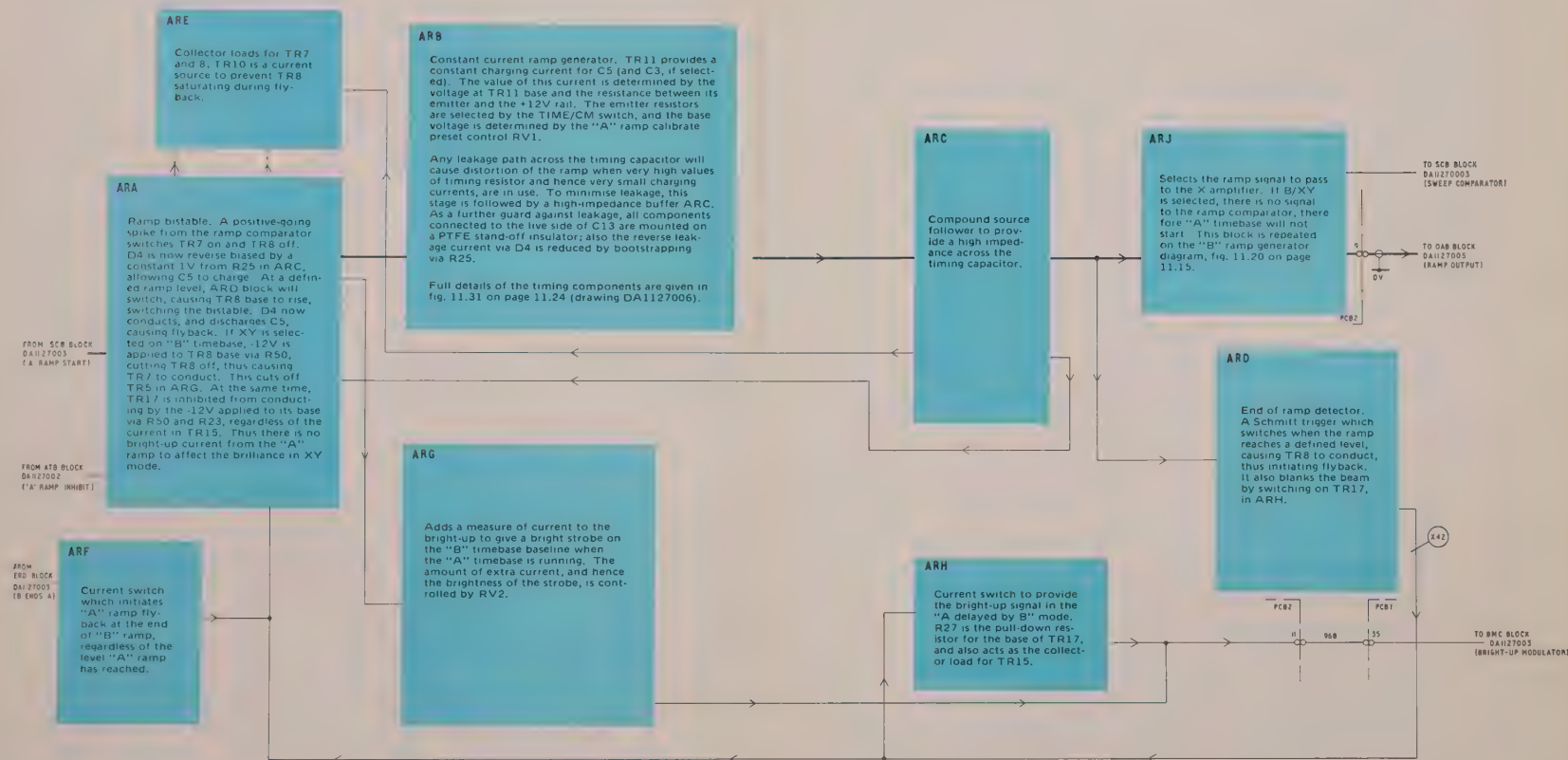


Fig. 11.20 "B" Ramp Generator, Sweep Comparator and Single Shot (DA1127003)



#### Procedure 112 Cal 4 "A" timebase speed.

1. Set delay mode selector to "A delayed by B"; set CM DELAY to 0.03; set both TIME/CM switches to 0.5ms; select INT trigger and AC coupling.
2. Display 2KHz markers from Bradley 192.
3. Adjust RV1 on pcb no. 2 for maximum accuracy over the centre 8cm. RV1 is a multi-turn preset potentiometer and is accessible from above the pcb.

#### Procedure 112 Cal 5 Intensified trace contrast.

1. Select "B intensified by A"; B TIME/CM to 0.5ms and A TIME/CM to 50μs; select INT trigger and AUTO mode; set BRILL control for normal viewing.
2. Adjust RV2 on pcb no. 2 for desired contrast.

Fig. 11.21 "A" Ramp Generator Block Diagram

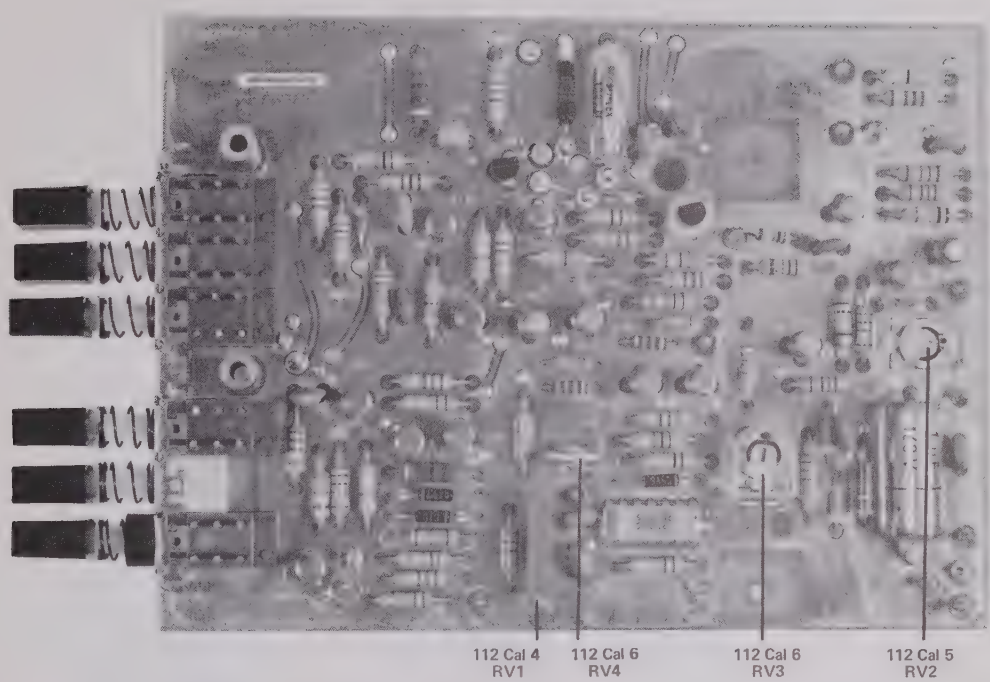


Fig. 11.22      PCB no. 2 Calibration Details

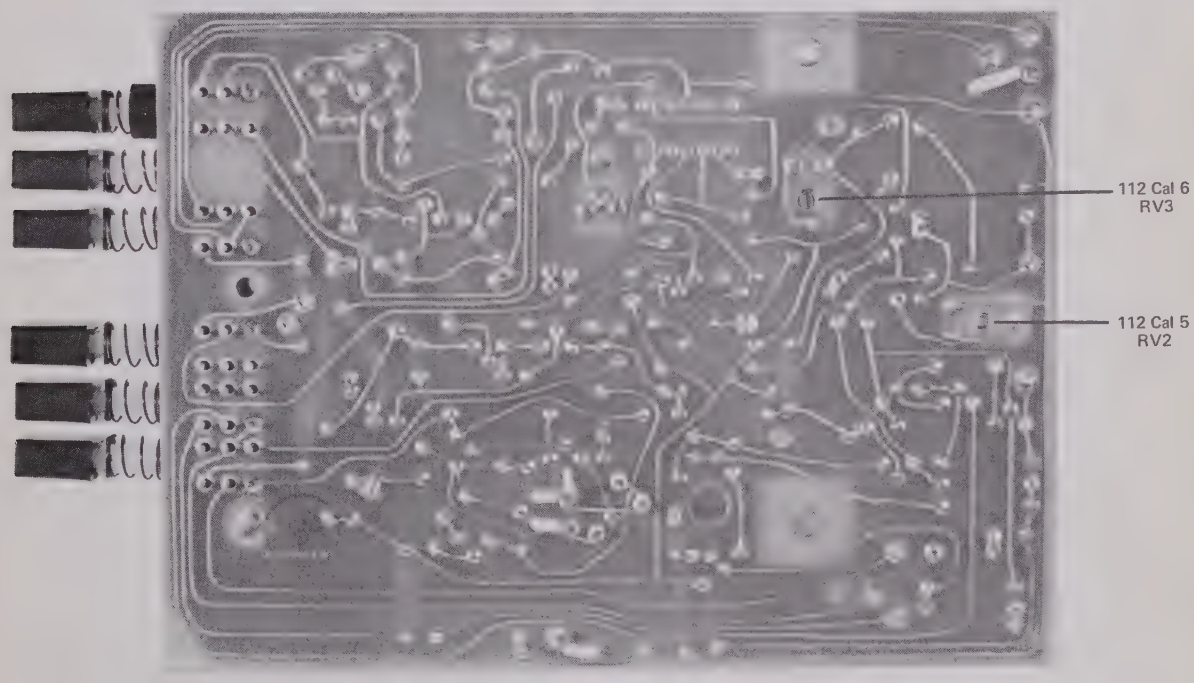


Fig. 11.23      PCB no. 2

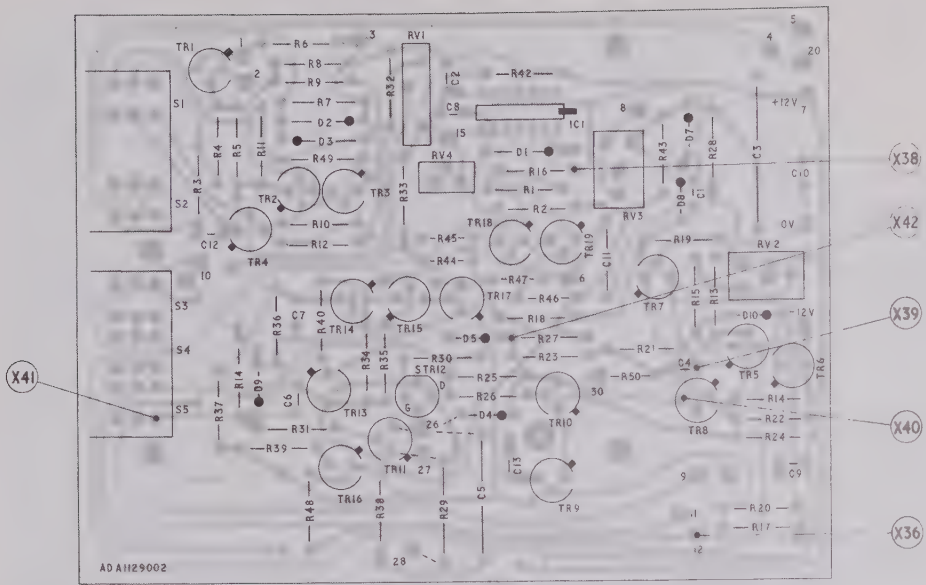
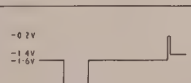


**Fig. 11.24 PCB no. 2 (Copper Side)**

Table 11.5 Test Information Points X36 and X38 to X42 - "A" Ramp Generator

| Point     | Measurement at Standard Settings                                                   | Remarks                                                                                                                         |
|-----------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| M16 (TP6) |   | This waveform does not appear on this drawing. It is included to facilitate time correlation with "B" ramp generator waveforms. |
| X36       |   |                                                                                                                                 |
| X38       |   | See Fig. 11.20. The rising edge is differentiated and applied to TR7 base. The spike is too narrow to be easily displayed.      |
| X39       |   |                                                                                                                                 |
| X40       |   |                                                                                                                                 |
| X41       |   |                                                                                                                                 |
| X42       |  |                                                                                                                                 |

All waveforms are time-related.

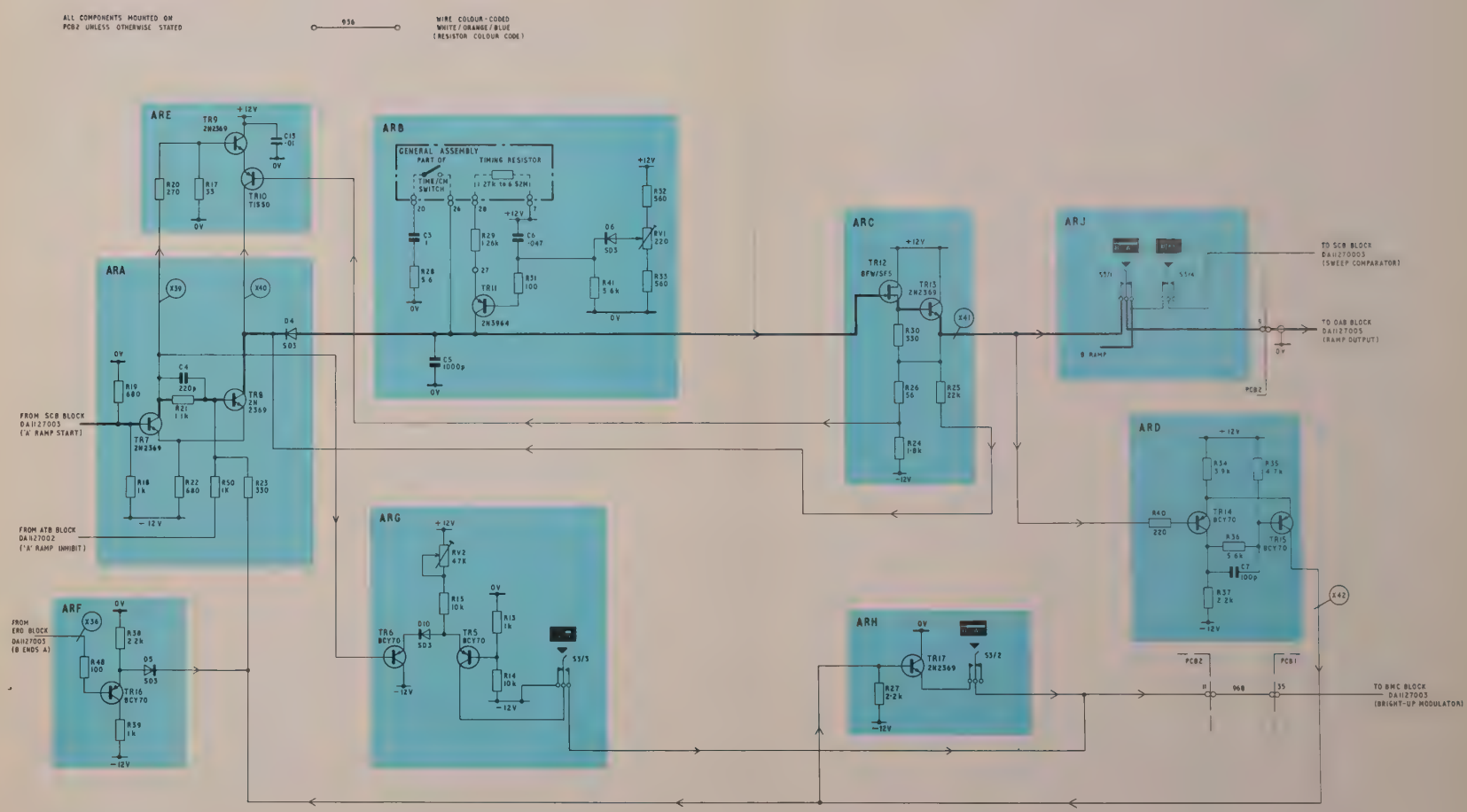


Fig. 11.25 "A" Ramp Generator (DA1127004)

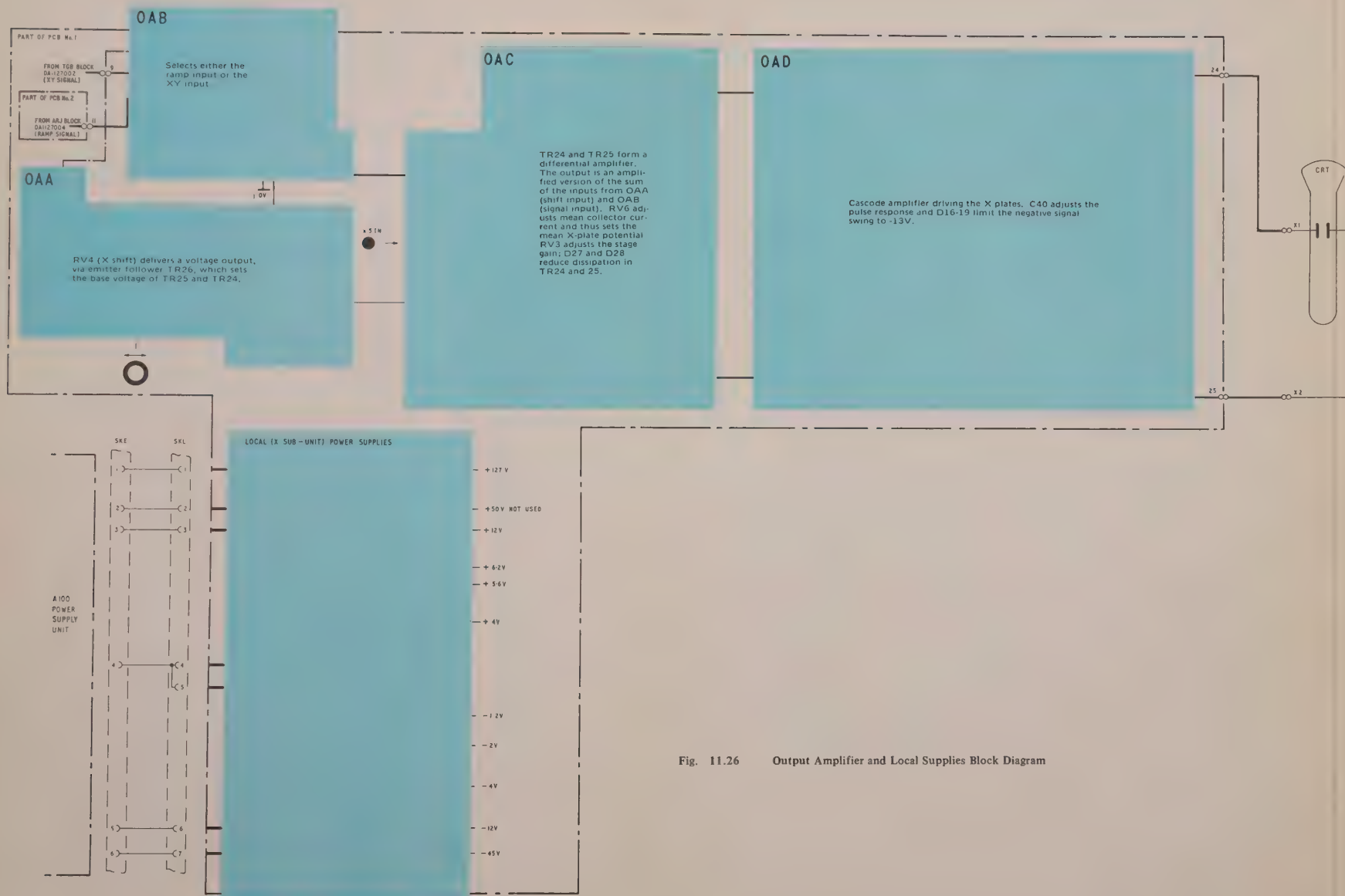


Fig. 11.26 Output Amplifier and Local Supplies Block Diagram

**Procedure 112 Cal 1.** Mean plate potential.

1. Connect AVO between X plates. Switch B TIME/CM to XY, and adjust X shift for zero volts reading.
2. Transfer negative AVO lead to chassis. Adjust RV6 on pcb no. 1 for  $40V \pm 1V$ .

**Procedure 112 Cal 2.** Horizontal gain and LF pulse response.

1. Switch B TIME/CM to XY, set trigger coupling to DC, and trigger source to EXT. Press X5 IN.
2. Connect 1KHz square wave output of the Bradley 192 at 800mV amplitude to EXT X input. Two horizontally opposed spots will appear.
3. Adjust X shift control and RV3 on pcb no. 1 to place the spots behind the 2nd and 10th graticule lines (i.e. 8cm apart).
4. Switch trigger source to EXT  $\div 10$ , and release X5 IN button. Increase the input signal to 40V amplitude.
5. Adjust C39 on pcb no. 1 to remove any feathering around the spots. C39 is accessible from underneath. See fig. 11.27.

**Procedure 112 Cal 7.** HF linearity and sweep speed check.

1. Set B TIME/CM to  $0.1\mu s/cm$ , press X5 IN. Select B(or B/XY), INT trigger, AC trigger coupling.
2. Display 50MHz signal from Bradley 192.
3. Adjust C40 on pcb no. 1 for maximum accuracy over the 8cm.
4. Release X5 IN button.
5. Check all sweep speeds on B timebase for specified accuracy using time markers from Bradley 192. If necessary readjust RV2 on pcb no. 1 to bring all speeds within specification.
6. Select "A delayed by B". Set CM DELAY to 0.30.
7. Repeat para. 5 for A timebase, readjusting RV1 on pcb no. 2 if necessary. The A and B timebase should run at the same speed for this adjustment.

**Procedure 112 Cal 8.**

1. Set B TIME/CM to XY; set trigger source to EXT; check that the X5 IN button is released.
2. Inject a 50KHz signal from Tektronix 191, via a  $50\Omega$  in-line termination, to EXT X socket. Set amplitude for a line 5.7cm wide, symmetrical about the vertical centre-line.
3. Increase the generator frequency until the line shortens to 4cm. Verify that this frequency is not less than 8MHz. If it is less than 8MHz, re-check the adjustment of C40 (112 Cal 7, para. 3).

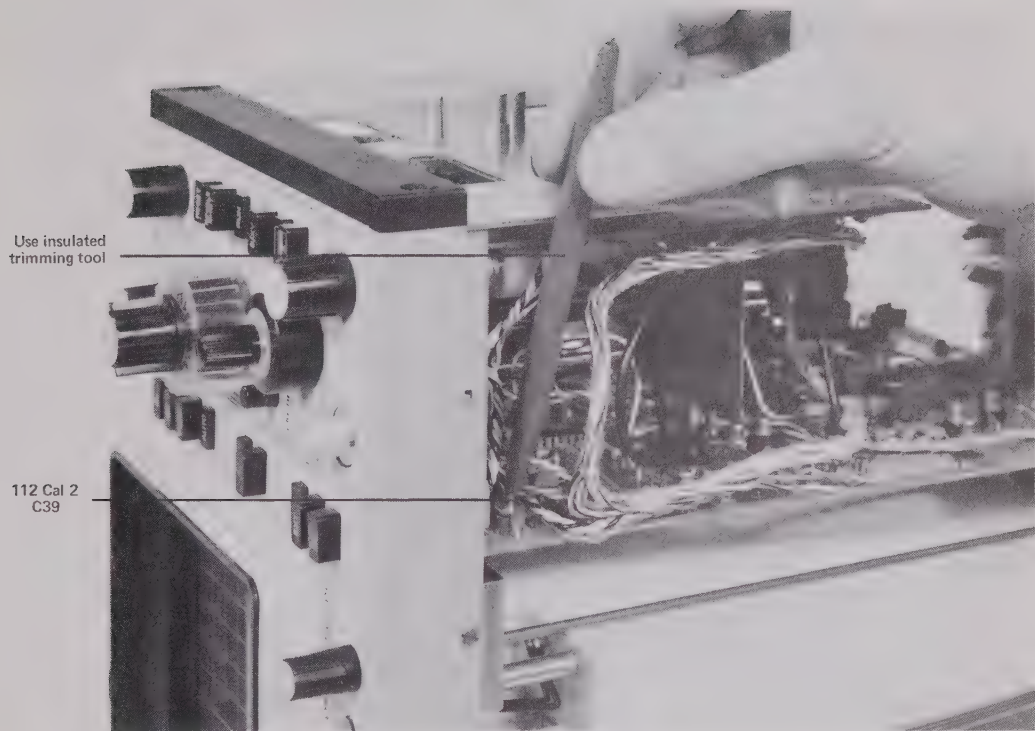


Fig. 11.27 Access to C39

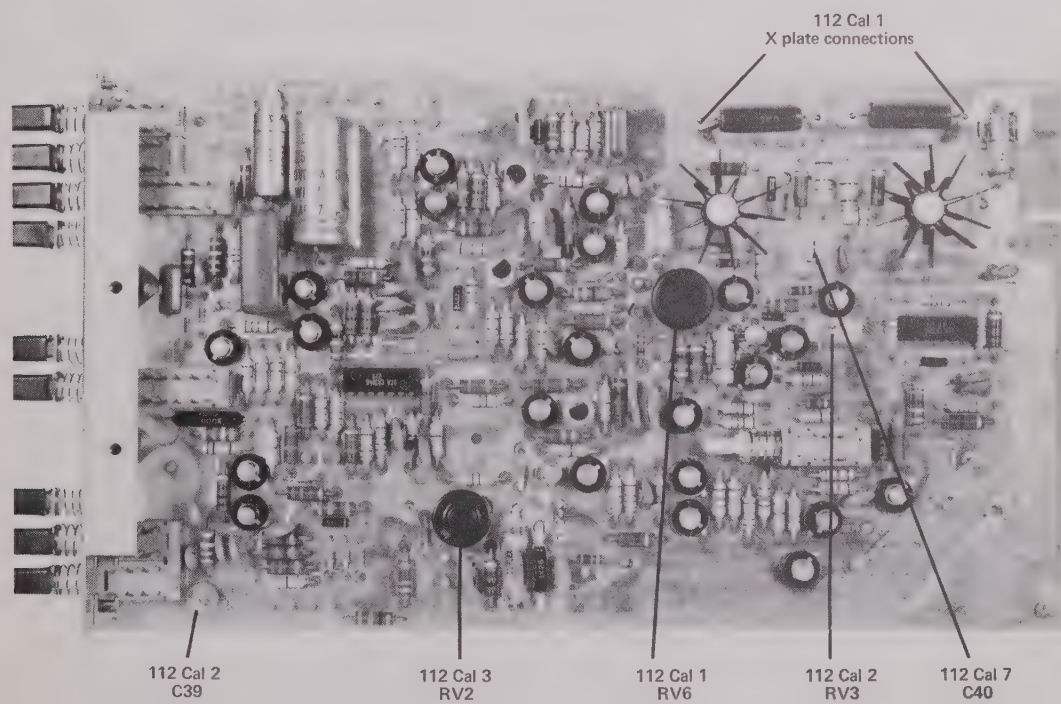


Fig. 11.28 PCB no. 1 Calibration Details

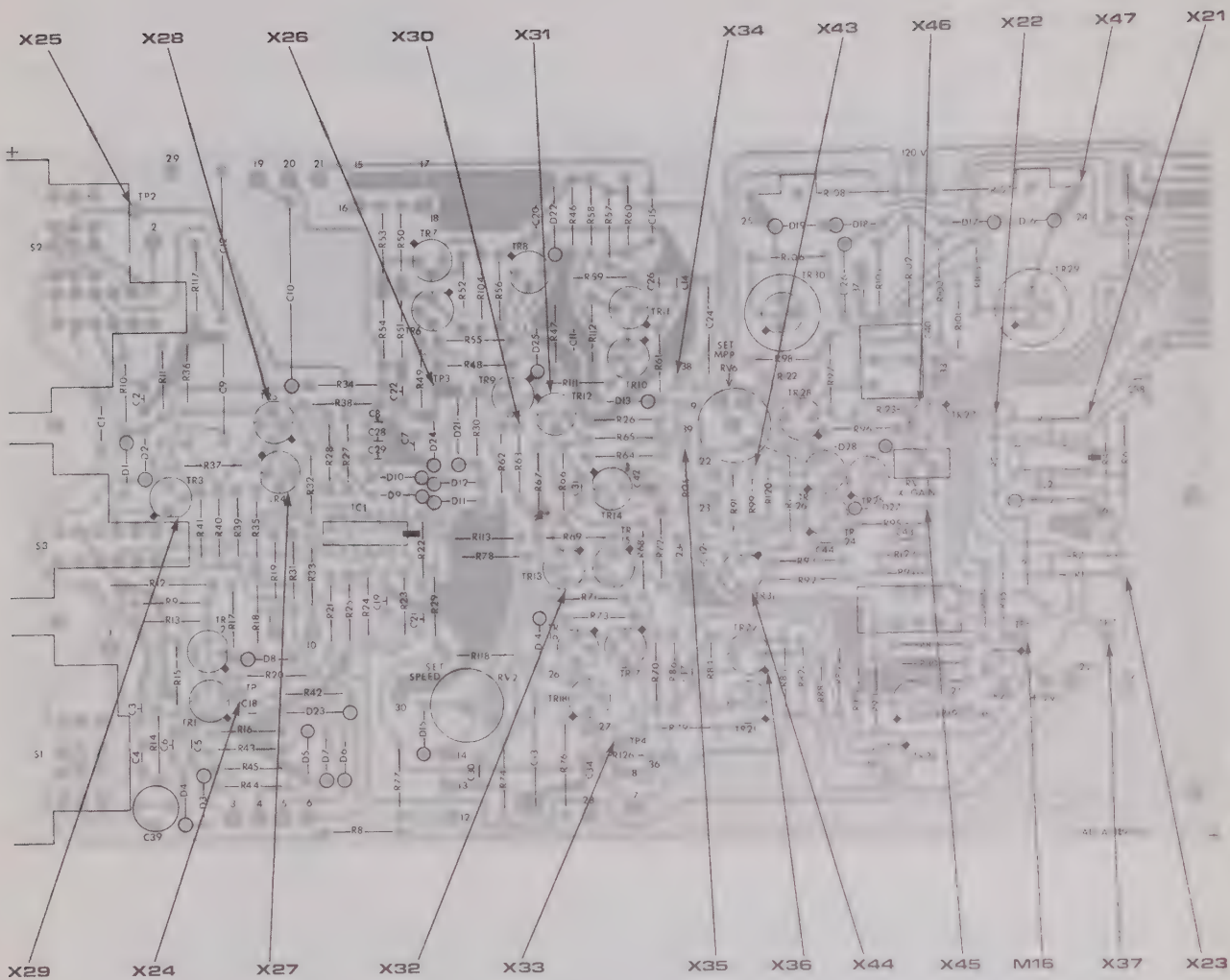


Fig. 11.29 PCB no. 1 (Component Side)

Table 11.6 Test Information Points X43 to X47 - Output Amplifier

| Point | Measurement at Standard Settings                                                  | Remarks |
|-------|-----------------------------------------------------------------------------------|---------|
| X43   | +0.93v                                                                            |         |
| X44   | +4.45v                                                                            |         |
| X45   |  |         |
| X46   |  |         |
| X47   |  |         |

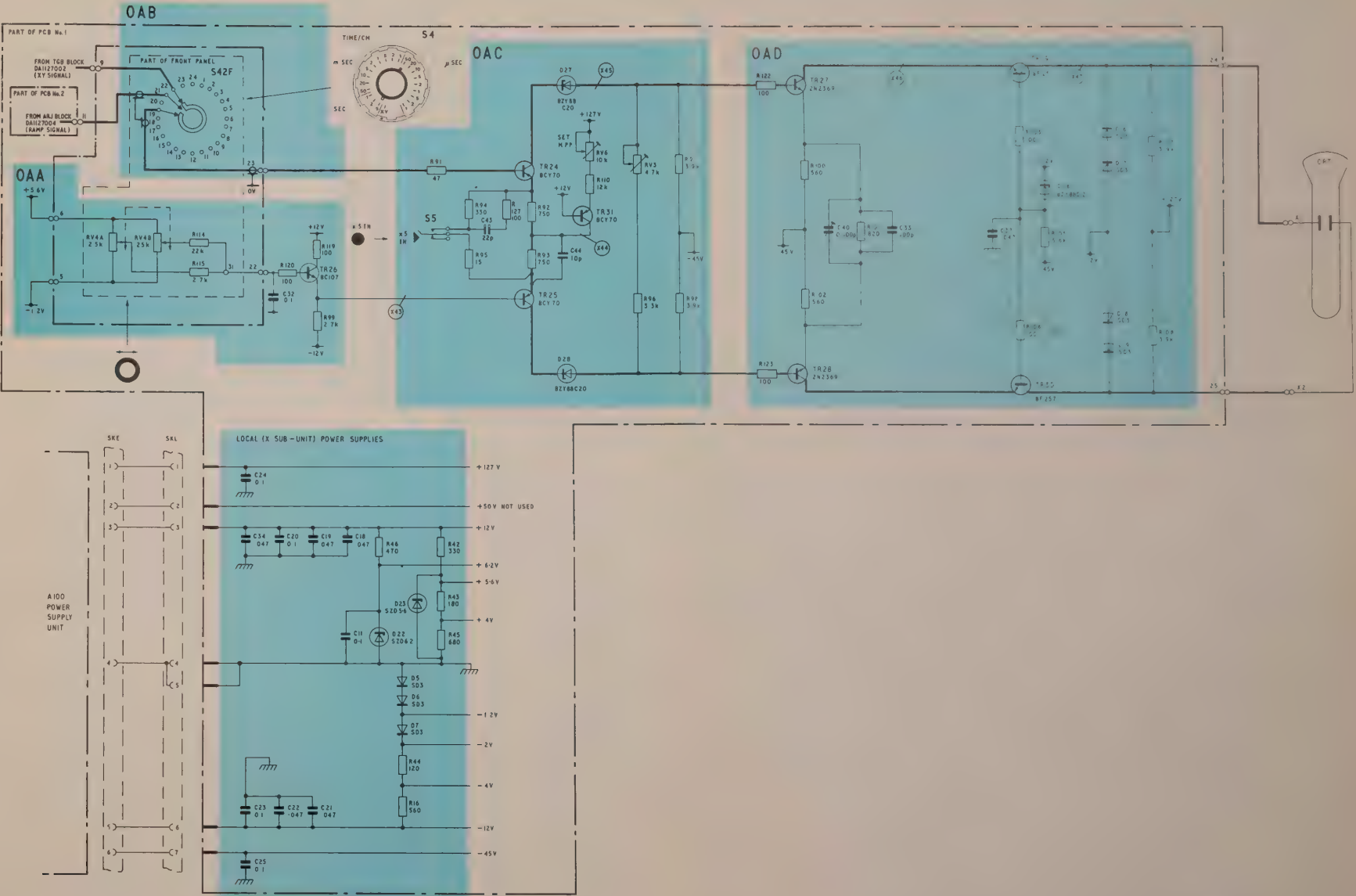


Fig. 11.30 Output Amplifier and Local Supplies (DA1127005)

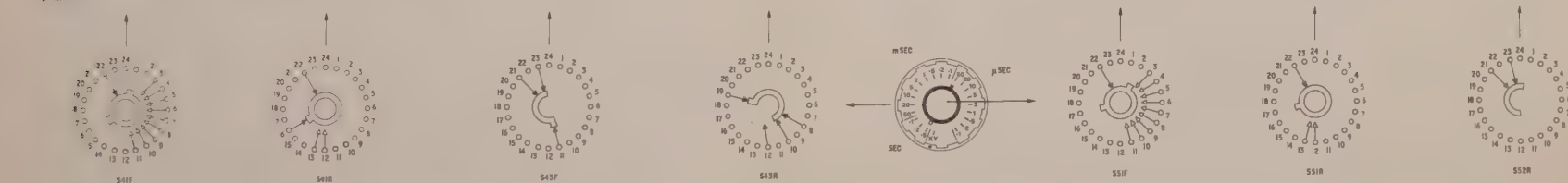
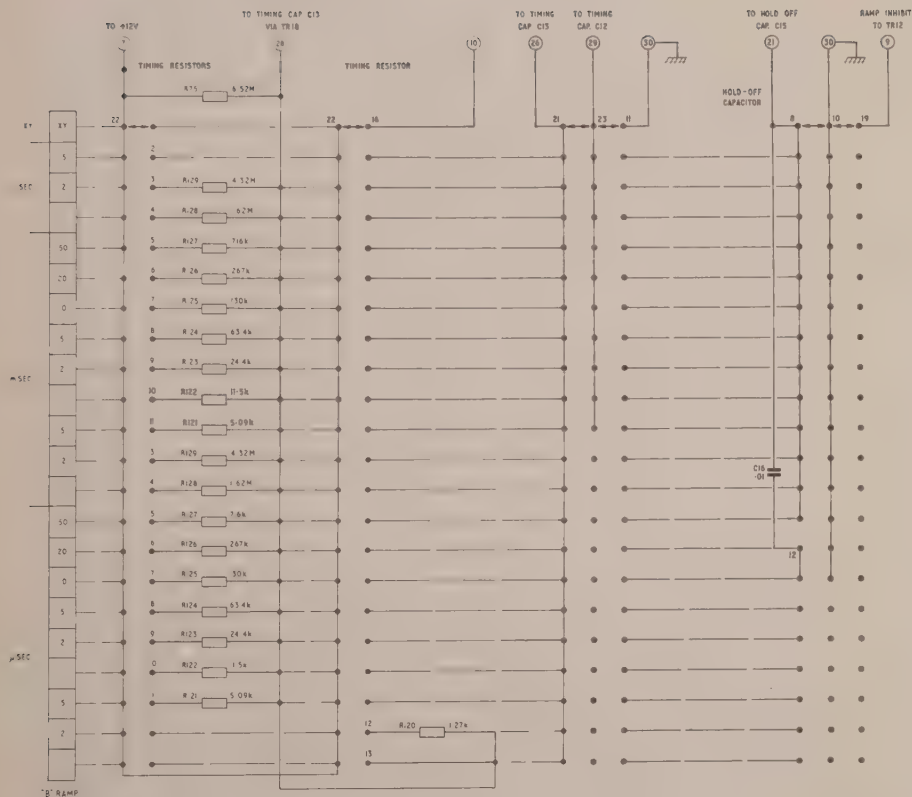
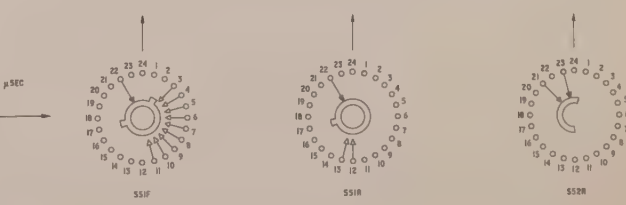
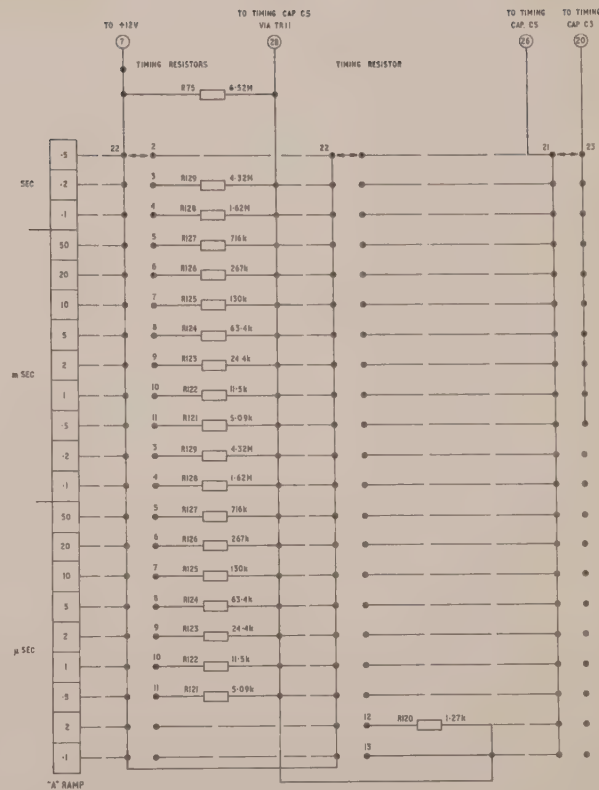


Fig. 11.31 TIME/CM Switch (DA1127006)



| COMPONENT PARTS LIST                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| ABBREVIATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| <p><b>Circuit References</b></p> <p>B Battery<br/>C Capacitor (μF)<br/>CSR Thyristor<br/>D Diode<br/>FS Fuse<br/>IC Integrated Circuit<br/>L Inductor<br/>LP Lamp (including Neon)<br/>LK Link<br/>M Meter<br/>MSP Mains Selector Panel<br/>PL Plug<br/>R Resistor (Ω)<br/>RL Relay<br/>S Switch<br/>SK Socket<br/>T Transformer<br/>TP Terminal Post (or Test Point)<br/>TR Transistor<br/>V Valve<br/>X Other Components</p> <p>Also Used:-<br/>RNL Non Linear Resistor (Ω)<br/>RV Variable Resistor (Ω)</p> <p><b>Component Composition</b></p> <p><b>FIXED RESISTORS</b></p> <p>Carbon Composition CACP<br/>Carbon Film CAFM<br/>Cracked Carbon CKCA<br/>Metal Film MEFM<br/>Metal Oxide MEOX<br/>Power Wirewound PRWW<br/>Precision Wirewound TEMP<br/>Thick Film TKFM<br/>Thin Film TNFM<br/>Voltage Sensitive VOLT</p>                                                                                                                                                       |  |
| <p><b>Component Composition (Cont'd)</b></p> <p><b>VARIABLE RESISTORS</b></p> <p>Wirewound Preset Single Turn WWPS<br/>Wirewound Preset Multiturn WWPM<br/>Wirewound Front Panel Single Turn WWFS<br/>Wirewound Front Panel Multiturn WWFM<br/>Carbon Preset Single Turn CAPS<br/>Carbon Preset Multiturn CAPM<br/>Carbon Front Panel Single Turn CAFS<br/>Carbon Front Panel Multiturn CAFM<br/>Cermet Preset Single Turn CMPS<br/>Cermet Preset Multiturn CMPM<br/>Cermet Front Panel Single Turn CMFS<br/>Cermet Front Panel Multiturn CMFM</p> <p><b>CAPACITORS</b></p> <p>Air AIR<br/>Aluminium Electrolytic ALME<br/>Aluminium Solid ALMS<br/>Carbon CARB<br/>Ceramic CERM<br/>Polyester Foil ESTF<br/>Polyester Metallised GLAS<br/>Glass GLAS<br/>Mica MICA<br/>Metallised Lacquer MLAC<br/>Paper Foil PAFP<br/>Paper Metallised PAFM<br/>PTFE PTFE<br/>Polypropylene Film PVLN<br/>Polystyrene STVR<br/>Tantalum Dry TAND<br/>Tantalum Foil TANF<br/>Tantalum Wet TANW</p> |  |

| Component Parts List     |                     | Component Parts List |                     |
|--------------------------|---------------------|----------------------|---------------------|
| for                      |                     | for                  |                     |
| Timebase Switch Assembly |                     | General Assembly     |                     |
| Cct. Ref.                | General Description | Cct. Ref.            | General Description |
| R75                      | MEFM 6.52M 1 .5     | R114                 | CACP 22k .25 10     |
| R116                     | CACP 10k .25 10     | R115                 | CACP 2.7k .25 10    |
| R120                     | MEFM 1.27k .25 .5   | RV1                  | CAFS 10k .5 20      |
| R121                     | MEFM 5.09k .25 .5   | RV4A                 | CAFS 2.5k .5 20     |
| R122                     | MEFM 11.5k .25 .5   | RV4B                 | CAFS 25k .5 20      |
| R123                     | MEFM 24.4k .25 .5   | RV5                  | CAFS 1k .5 20       |
| R124                     | MEFM 63.4k .25 .5   | RV6                  | WWFM 10k            |
| R125                     | MEFM 130k .25 .5    | V1                   | Neon Assembly       |
| R126                     | MEFM 267k .25 .5    |                      |                     |
| R127                     | MEFM 716k .5 .5     |                      |                     |
| R128                     | MEFM 1.62M .5 .5    |                      |                     |
| R129                     | MEFM 4.32M .5 .5    |                      |                     |
| C16                      | CERM .01 25 +50 -20 |                      |                     |

## Component Parts List

for

PCB no. 2 (A1129002)

| Cct. | Ref. |
|------|------|
|------|------|

### General Description

Solartron  
Part No.

|     |      |     |    |            |           |
|-----|------|-----|----|------------|-----------|
| C9  | CERM | .01 | 25 | +50<br>-20 | 241941000 |
| C10 | CERM | .01 | 25 | +50<br>-20 | 241941000 |
| C11 | TAND | 4.7 | 10 | 20         | 265464700 |
| C12 | CERM | .01 | 25 | +50<br>-20 | 241941000 |
| C13 | CERM | .01 | 25 | +50<br>-20 | 241941000 |

| Ref. | General Description |       |     |     | Solartron Part No. | C13      | CERM          | .01 | 25  | -20<br>+50<br>-20 | 241941000 |
|------|---------------------|-------|-----|-----|--------------------|----------|---------------|-----|-----|-------------------|-----------|
| R1   | MEOX                | 1k    | .5  | 5   | 193531000          |          |               |     |     |                   |           |
| R2   | MEOX                | 560   | .5  | 5   | 193525600          | D1       | Zener SZD 5.6 |     |     |                   | 300521450 |
| R3   | MEOX                | 1.8k  | .5  | 1   | 195431800          | D2       | Zener SZD 10  |     |     |                   | 300522760 |
| R4   | MEOX                | 6.8k  | .5  | 1   | 195436800          | D3       | Zener SZD 6.8 |     |     |                   | 300522540 |
| R5   | MEOX                | 1k    | .5  | 1   | 195431000          | D4       |               |     |     |                   |           |
| R6   | MEOX                | 82k   | .5  | 5   | 193548200          | to<br>D8 | SD3           |     |     |                   | 300522160 |
| R7   | MEOX                | 1.5k  | .5  | 1   | 195431500          |          |               |     |     |                   |           |
| R8   | MEOX                | 6.8k  | .5  | 5   | 193536800          | D10      | SD3           |     |     |                   | 300522160 |
| R9   | MEOX                | 27k   | .5  | 5   | 193542700          | TR1      | A1778         |     |     |                   | 300551430 |
| R10  | MEOX                | 15k   | .5  | 5   | 193541500          | TR2      | 2N2369        |     |     |                   | 300552390 |
| R11  | MEOX                | 3.3k  | .5  | 5   | 193533300          | TR3      | 2N2369        |     |     |                   | 300552390 |
| R12  | MEOX                | 6.8k  | .5  | 5   | 193536800          | TR4      | 2N2369        |     |     |                   | 300552390 |
| R13  | MEOX                | 1k    | .5  | 1   | 195431000          | TR5      | BCY70         |     |     |                   | 300553590 |
| R14  | MEOX                | 10k   | .5  | 1   | 195441000          | TR6      | BCY70         |     |     |                   | 300553590 |
| R15  | MEOX                | 10k   | .5  | 1   | 195441000          | TR7      | 2N2369        |     |     |                   | 300552390 |
| R16  | MEOX                | 100k  | .5  | 5   | 193551000          | TR8      | 2N2369        |     |     |                   | 300552390 |
| R17  | MEOX                | 33    | .5  | 5   | 193513300          | TR9      | 2N2369        |     |     |                   | 300552390 |
| R18  | MEOX                | 1k    | .5  | 1   | 195431000          | TR10     | TIS50         |     |     |                   | 300553720 |
| R19  | MEOX                | 680   | .5  | 1   | 195426800          | TR11     | BC214LC       |     |     |                   | 300554150 |
| R20  | MEOX                | 270   | .5  | 1   | 195422700          | TR12     | BFW/SF5       |     |     |                   | 300554060 |
| R21  | MEOX                | 1.1k  | .5  | 1   | 195431100          | TR13     | 2N2369        |     |     |                   | 300552390 |
| R22  | MEOX                | 680   | .5  | 1   | 195426800          | TR14     | BCY70         |     |     |                   | 300553590 |
| R23  | MEOX                | 330   | .5  | 1   | 195423300          | TR15     | BCY70         |     |     |                   | 300553590 |
| R24  | MEOX                | 1.8k  | .5  | 1   | 195431800          | TR16     | BCY70         |     |     |                   | 300553590 |
| R25  | MEOX                | 22k   | .5  | 5   | 193542200          | TR17     | 2N2369        |     |     |                   | 300552390 |
| R26  | MEOX                | 56    | .5  | 5   | 193515600          | TR18     | 2N2369        |     |     |                   | 300552390 |
| R27  | MEOX                | 2.2k  | .5  | 5   | 193532200          | TR19     | 2N2369        |     |     |                   | 300552390 |
| R28  | MEOX                | 5.6   | .25 | 10  | 172305600          |          |               |     |     |                   |           |
| R29  | MEFM                | 1.26k | .25 | 0.5 | 198231261          |          |               |     |     |                   |           |
| R30  | MEOX                | 330   | .5  | 5   | 193523300          |          |               |     |     |                   |           |
| R31  | MEOX                | 100   | .5  | 5   | 193521000          |          |               |     |     |                   |           |
| R32  | MEOX                | 560   | .5  | 5   | 193525600          |          |               |     |     |                   |           |
| R33  | MEOX                | 560   | .5  | 5   | 193525600          |          |               |     |     |                   |           |
| R34  | MEOX                | 3.9k  | .5  | 5   | 193533900          |          |               |     |     |                   |           |
| R35  | MEOX                | 4.7k  | .5  | 5   | 193534700          |          |               |     |     |                   |           |
| R36  | MEOX                | 5.6k  | .5  | 5   | 193535600          |          |               |     |     |                   |           |
| R37  | MEOX                | 2.2k  | .5  | 5   | 193532200          | R1       | CACP          | 1k  | .25 | 10                | 172331000 |
| R38  | MEOX                | 2.2k  | .5  | 5   | 193532200          | R2       | MEOX          | 820 | .5  | 1                 | 195428200 |
| R39  | MEOX                | 1k    | .5  | 5   | 193531000          | R3       | MEOX          | 1k  | .5  | 1                 | 195431000 |
| R40  | MEOX                | 220   | .5  | 5   | 193522200          | R4       | MEOX          | 820 | .5  | 1                 | 195428200 |
| R41  | MEOX                | 5.6k  | .5  | 5   | 193535600          | R5       | CACP          | 27  | .25 | 10                | 172312700 |
| R42  | MEOX                | 12k   | .5  | 5   | 193541200          | R6       | CACP          | 10  | .25 | 10                | 172311000 |
| R43  | MEOX                | 1.8k  | .5  | 5   | 193531800          | R7       | MEOX          | 820 | .5  | 1                 | 195428200 |
| R44  | MEOX                | 18k   | .25 | 5   | 195641800          | R8       | CACP          | 47  | .25 | 10                | 172314700 |
|      |                     |       |     |     |                    |          |               |     |     |                   |           |

| Cct.<br>Ref. | General Description |       |     |     |  | Solartron<br>Part No. | Cct.<br>Ref. | General Description |       |      |     |  | Solartron<br>Part No. |
|--------------|---------------------|-------|-----|-----|--|-----------------------|--------------|---------------------|-------|------|-----|--|-----------------------|
| R25          | MEOX                | 1k    | .5  | 1   |  | 195431000             | R98          | MEOX                | 3.9k  | .5   | 1   |  | 195433900             |
| R26          | CACP                | 33    | .25 | 10  |  | 172313300             | R99          | CACP                | 2.7k  | .25  | 10  |  | 172332700             |
| R27          | CACP                | 100   | .25 | 10  |  | 172321000             | R100         | MEOX                | 560   | 1    | 1   |  | 197525600             |
| R28          | CACP                | 100   | .25 | 10  |  | 172321000             | R101         | MEOX                | 820   | .5   | 1   |  | 195428200             |
| R29          | MEOX                | 68    | .5  | 5   |  | 193516800             | R102         | MEOX                | 560   | 1    | 1   |  | 197525600             |
| R30          | MEOX                | 680   | .5  | 1   |  | 195426800             | R103         | CACP                | 100   | .25  | 10  |  | 172321000             |
| R31          | MEOX                | 5.6k  | .5  | 1   |  | 195435600             | R104         | CACP                | 100   | .25  | 10  |  | 172321000             |
| R32          | MEOX                | 39    | .5  | 1   |  | 195413900             | R105         | CACP                | 5.6k  | .25  | 10  |  | 172335600             |
| R33          | MEOX                | 2.7k  | .5  | 1   |  | 195432700             | R106         | CACP                | 100   | .25  | 10  |  | 172321000             |
| R34          | MEOX                | 12k   | .5  | 1   |  | 195441200             | R107         | POWW                | 3.9k  | 6    | 1   |  | 173633900             |
| R35          | MEOX                | 3.9k  | .5  | 5   |  | 193533900             | R108         | POWW                | 3.9k  | 6    | 1   |  | 173633900             |
| R36          | MEOX                | 100   | .5  | 5   |  | 193521000             | R109         | MEOX                | 3.3k  | .5   | 5   |  | 193533300             |
| R37          | MEOX                | 1.8k  | .5  | 1   |  | 195431800             | R110         | MEOX                | 12k   | 1    | 5   |  | 193441200             |
| R38          | CACP                | 1k    | .25 | 10  |  | 172331000             | R111         | CACP                | 220   | .25  | 10  |  | 172322200             |
| R39          | MEOX                | 3.3k  | .5  | 1   |  | 195433300             | R112         | CACP                | 220   | .25  | 10  |  | 172322200             |
| R40          | MEOX                | 3.3k  | .5  | 1   |  | 195433300             | R113         | CACP                | 5.6k  | .25  | 10  |  | 172335600             |
| R41          | MEOX                | 3.9k  | .5  | 1   |  | 195433900             | R117         | CACP                | 5.6   | .25  | 10  |  | 172305600             |
| R42          | CACP                | 330   | .25 | 10  |  | 172323300             | R118         | MEOX                | 560   | .5   | 5   |  | 193525600             |
| R43          | CACP                | 180   | .25 | 10  |  | 172321800             | R119         | CACP                | 100   | .125 | 10  |  | 172021000             |
| R44          | CACP                | 120   | .25 | 10  |  | 172321200             | R120         | CACP                | 100   | .125 | 10  |  | 172021000             |
| R45          | CACP                | 680   | .25 | 10  |  | 172326800             | R122         | CACP                | 100   | .125 | 10  |  | 172021000             |
| R46          | CACP                | 470   | .25 | 10  |  | 172324700             | R123         | CACP                | 100   | .125 | 10  |  | 172021000             |
| R47          | MEOX                | 47    | .5  | 5   |  | 193514700             | R125         | CACP                | 100   | .125 | 10  |  | 172021000             |
| R48          | MEOX                | 1.5k  | .5  | 1   |  | 195431500             | R126         | CACP                | 100   | .125 | 10  |  | 172021000             |
| R49          | CACP                | 47    | .25 | 10  |  | 172314700             | R127         | CACP                | 100   | .125 | 10  |  | 172021000             |
| R50          | MEOX                | 47    | .5  | 1   |  | 195414700             | RV2          | WWPS                | 220   | 1    | 10  |  | 110037230             |
| R51          | MEOX                | 3.9k  | .5  | 1   |  | 195433900             | RV3          | CAPS                | 4.7k  | 0.5  | 20  |  | 137334700             |
| R52          | CACP                | 180   | .25 | 10  |  | 172321800             | RV6          | CAPS                | 10k   | 0.5  | 20  |  | 136641000             |
| R53          | MEOX                | 82    | .5  | 1   |  | 195418200             | C1           | ESTF                | .033  | 400  | 10  |  | 226043300             |
| R54          | MEOX                | 2.7k  | .5  | 1   |  | 195432700             | C2           | CERM                | 220p  | 500  | 20  |  | 241322200             |
| R55          | CACP                | 47    | .25 | 10  |  | 172314700             | C3           | CERM                | 68p   | 500  | 20  |  | 241316800             |
| R56          | MEOX                | 820   | .5  | 1   |  | 195428200             | C4           | CERM                | 1000p | 500  | 20  |  | 241331000             |
| R57          | MEOX                | 1k    | .5  | 1   |  | 195431000             | C5           |                     |       |      |     |  |                       |
| R58          | MEOX                | 390   | .5  | 1   |  | 195423900             | to           | CERM                | .047  | 25   | +50 |  | 241944700             |
| R59          | MEOX                | 1k    | .5  | 1   |  | 195431000             | C8           |                     |       |      |     |  |                       |
| R60          | MEOX                | 1.5k  | .5  | 1   |  | 195431500             | C9           | ESTM                | 2.2   | 100  | 10  |  | 225462200             |
| R61          | MEOX                | 1k    | .5  | 1   |  | 195431000             | C10          | ALME                | 250   | 25   | +50 |  | 270782500             |
| R62          | MEOX                | 680   | .5  | 1   |  | 195426800             |              |                     |       |      | -10 |  |                       |
| R63          | MEOX                | 1k    | .5  | 1   |  | 195431000             | C11          | CERM                | .1    | 30   | +50 |  | 242051000             |
| R64          | CACP                | 2.2k  | .25 | 10  |  | 172332200             |              |                     |       |      | -20 |  |                       |
| R65          | MEOX                | 270   | .5  | 1   |  | 195422700             | C12          | ESTM                | 1     | 160  | 1   |  | 220061000             |
| R66          | MEOX                | 1.1k  | .5  | 1   |  | 195431100             | C13          | STYR                | 1000p | 630  | 1   |  | 210331000             |
| R67          | MEOX                | 680   | .5  | 1   |  | 195426800             |              |                     |       |      |     |  |                       |
| R68          | MEOX                | 330   | .5  | 5   |  | 193523300             | C14          | CERM                | 1500p | 500  | 20  |  | 241331500             |
| R69          | CACP                | 1.8k  | .25 | 10  |  | 172331800             | C15          | ESTM                | .1    | 100  | 10  |  | 225451000             |
| R70          | MEOX                | 2.2k  | .5  | 1   |  | 195432200             | C17          | CERM                | 100p  | 500  | 20  |  | 241321000             |
| R71          | CACP                | 22k   | .25 | 10  |  | 172342200             | C18          | CERM                | .047  | 25   | +50 |  | 241944700             |
| R72          | CACP                | 56    | .25 | 10  |  | 172315600             |              |                     |       |      | -20 |  |                       |
| R73          | MEOX                | 330   | .5  | 5   |  | 193523300             | C19          | CERM                | .047  | 25   | +50 |  | 241944700             |
| R74          | CACP                | 100   | .25 | 10  |  | 172321000             |              |                     |       |      | -20 |  |                       |
| R76          | MEFM                | 1.26k | .25 | 0.5 |  | 198231261             | C20          | CERM                | .1    | 30   | +50 |  | 242051000             |
| R77          | CACP                | 4.7k  | .25 | 10  |  | 172334700             |              |                     |       |      | -20 |  |                       |
| R78          | MEOX                | 560   | .5  | 5   |  | 193525600             | C21          | CERM                | .047  | 25   | +50 |  | 241944700             |
| R79          | CACP                | 220   | .25 | 10  |  | 172322200             |              |                     |       |      | -20 |  |                       |
| R80          | MEOX                | 1k    | .5  | 1   |  | 195431000             | C22          | CERM                | .047  | 25   | +50 |  | 241944700             |
| R81          | MEOX                | 1k    | .5  | 1   |  | 195431000             |              |                     |       |      | -20 |  |                       |
| R82          | MEOX                | 3.9k  | .5  | 1   |  | 195433900             | C23          | CERM                | .1    | 30   | +50 |  | 242051000             |
| R83          | MEOX                | 4.7k  | .5  | 1   |  | 195434700             |              |                     |       |      | -20 |  |                       |
| R84          | MEOX                | 5.6k  | .5  | 1   |  | 195435600             | C24          | ESTM                | .1    | 160  | 10  |  | 220351000             |
| R85          | CACP                | 220   | .25 | 10  |  | 172322200             | C25          | ESTM                | .1    | 160  | 10  |  | 220351000             |
| R86          | MEOX                | 2.2k  | .5  | 1   |  | 195432200             | C26          | CERM                | .01   | 25   | +50 |  | 241941000             |
| R87          | CACP                | 100   | .25 | 10  |  | 172321000             |              |                     |       |      | -20 |  |                       |
| R88          | MEOX                | 1k    | .5  | 1   |  | 195431000             | C27          |                     |       |      |     |  |                       |
| R89          | MEOX                | 680   | .5  | 1   |  | 195426800             | to           | CERM                | .047  | 25   | +50 |  | 241944700             |
| R90          | MEOX                | 4.7k  | .5  | 5   |  | 193534700             | C30          |                     |       |      | -20 |  |                       |
| R91          | CACP                | 47    | .25 | 10  |  | 172314700             | C31          | CERM                | 220p  | 500  | 20  |  | 241322200             |
| R92          | MEOX                | 750   | .5  | 1   |  | 195427500             | C32          | CERM                | .1    | 30   | +50 |  | 242051000             |
| R93          | MEOX                | 750   | .5  | 1   |  | 195427500             |              |                     |       |      | -20 |  |                       |
| R94          | MEOX                | 330   | .25 | 1   |  | 195323300             | C33          | CERM                | 100p  | 500  | 20  |  | 241321000             |
| R95          | MEOX                | 15    | .5  | 5   |  | 193511500             | C34          | CERM                | .047  | 25   | +50 |  | 241944700             |
| R96          | CACP                | 3.3k  | .25 | 10  |  | 172333300             |              |                     |       |      | -20 |  |                       |
| R97          | MEOX                | 3.9k  | .5  | 1   |  | 195433900             | C35          | CERM                | 1000p | 500  | 20  |  | 241331000             |
|              |                     |       |     |     |  |                       | C36          | CERM                | .047  | 25   | +50 |  | 241944700             |
|              |                     |       |     |     |  |                       |              |                     |       |      | -20 |  |                       |

| Cct.<br>Ref.    | General Description |        |     |     | Solartron<br>Part No. | Cct.<br>Ref. | General Description |  |  |  | Solartron<br>Part No. |
|-----------------|---------------------|--------|-----|-----|-----------------------|--------------|---------------------|--|--|--|-----------------------|
| C37             | CERM                | .047   | 25  | +50 | 241944700             | TR1          | FET BFW/SF5         |  |  |  | 300554060             |
| C38             | CERM                | 150p   | 500 | -20 | 241321500             | TR2          | 2N2369A             |  |  |  | 300552390             |
| C39             | ESTF                | 2-22p  |     | 20  | 290030180             | TR3          | BCY70               |  |  |  | 300553590             |
| C40             | PTFE                | 4-104p |     |     | 290030130             | TR4          | BC107S              |  |  |  | 300553320             |
| C42             | CERM                | 470p   | 500 | 20  | 241324700             | TR5          | BC107S              |  |  |  | 300553320             |
| C43             | CERM                | 22p    | 500 | 20  | 241312200             | TR6          | 2N2369A             |  |  |  | 300552390             |
| C44             | CERM                | 10p    | 500 | 20  | 241311000             | TR7          | 2N2369A             |  |  |  | 300552390             |
| D1<br>to<br>D19 | SD3                 |        |     |     | 300522160             | TR8          | TIS 50              |  |  |  | 300553820             |
| D20             | Zener BZY88 C3V9    |        |     |     | 300521420             | TR9          | TIS 50              |  |  |  | 300553720             |
| D21             | Zener BZY88 C6V2    |        |     |     | 300521240             | TR10         | BCY70               |  |  |  | 300553590             |
| D22             | Zener BZY88 C6V2    |        |     |     | 300521240             | TR11         | BCY70               |  |  |  | 300553590             |
| D23             | Zener BZY88 C5V6    |        |     |     | 300521450             | TR12         | 2N2369A             |  |  |  | 300553590             |
| D24             | Tunnel Diode AEY25  |        |     |     | 300524710             | TR13         | 2N2369A             |  |  |  | 300553590             |
| D25             | Tunnel Diode AEY25  |        |     |     | 300524710             | TR14         | 2N2369A             |  |  |  | 300553590             |
| D26             | Zener BZY88 C12     |        |     |     | 300521480             | TR15         | TIS 50              |  |  |  | 300553720             |
| D27             | Zener BZY88 C20     |        |     |     | 300523790             | TR16         | FET BFW/SF5         |  |  |  | 300554060             |
| D28             | Zener BZY88 C20     |        |     |     | 300523790             | TR17         | 2N2369A             |  |  |  | 300552390             |
|                 |                     |        |     |     |                       | TR18         | BC214LC             |  |  |  | 300554150             |
|                 |                     |        |     |     |                       | TR19         | 2N2369A             |  |  |  | 300552390             |
|                 |                     |        |     |     |                       | TR20         | 2N2369A             |  |  |  | 300552390             |
|                 |                     |        |     |     |                       | TR21         | BCY70               |  |  |  | 300552390             |
|                 |                     |        |     |     |                       | TR22         | BCY70               |  |  |  | 300552390             |
|                 |                     |        |     |     |                       | TR23         | BCY70               |  |  |  | 300552390             |
|                 |                     |        |     |     |                       | TR24         | SM6526              |  |  |  | 300552990             |
|                 |                     |        |     |     |                       | TR25         | BC107S              |  |  |  | 300552990             |
|                 |                     |        |     |     |                       | TR26         | BC107S              |  |  |  | 300553320             |
|                 |                     |        |     |     |                       | TR27         | 2N2369A             |  |  |  | 300552390             |
|                 |                     |        |     |     |                       | TR28         | 2N2369A             |  |  |  | 300552390             |
|                 |                     |        |     |     |                       | TR29         | BF257               |  |  |  | 300554120             |
|                 |                     |        |     |     |                       | TR30         | BF257               |  |  |  | 300554120             |
|                 |                     |        |     |     |                       | TR31         | BCY70               |  |  |  | 300553590             |
|                 |                     |        |     |     |                       | IC1          | SL3045              |  |  |  | 300554090             |
|                 |                     |        |     |     |                       | IC2          | SL3045              |  |  |  | 300554090             |
|                 |                     |        |     |     |                       | SW5          | Switch Push Button  |  |  |  | 379601001             |





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